TUM School of Life Sciences
Technische Universität München

Modulhandbuch

M.Sc. Sustainable Resource Management

TUM School of Life Sciences
Technische Universität München

www.tum.de/
www.wzw.tum.de/index.php?id=2&L=1

Allgemeine Informationen und Lesehinweise zum Modulhandbuch

Zu diesem Modulhandbuch:
Ein zentraler Baustein des Bologna-Prozesses ist die Modularisierung der Studiengänge, das heißt die Umstellung des vormaligen Lehrveranstaltungssystems auf ein Modulsystem, in dem die Lehrveranstaltungen zu thematisch zusammenhängenden Veranstaltungsblöcken - also Modulen - gebündelt sind. Dieses Modulhandbuch enthält die Beschreibungen aller Module, die im Studiengang angeboten werden. Das Modulhandbuch dient der Transparenz und versorgt Studierende, Studieninteressierte und andere interne und externe Adressaten mit Informationen über die Inhalte der einzelnen Module, ihre Qualifikationsziele sowie qualitative und quantitative Anforderungen.

Wichtige Lesehinweise:

Aktualität
Jedes Semester wird der aktuelle Stand des Modulhandbuchs veröffentlicht. Das Generierungsdatum (siehe Fußzeile) gibt Auskunft, an welchem Tag das vorliegende Modulhandbuch aus TUMonline generiert wurde.

Rechtsverbindlichkeit
Modulbeschreibungen dienen der Erhöhung der Transparenz und der besseren Orientierung über das Studienangebot, sind aber nicht rechtsverbindlich. Einzelne Abweichungen zur Umsetzung der Module im realen Lehrbetrieb sind möglich. Eine rechtsverbindliche Auskunft über alle studien- und prüfungsrelevanten Fragen sind den Fachprüfungs- und Studienordnungen (FPSOen) der Studiengänge sowie der allgemeinen Prüfungs- und Studienordnung der TUM (APSO) zu entnehmen.

Wahlmodule
Wenn im Rahmen des Studiengangs Wahlmodule aus einem offenen Katalog gewählt werden können, sind diese Wahlmodule in der Regel nicht oder nicht vollständig im Modulhandbuch gelistet.

Verzeichnis Modulbeschreibungen (SPO-Baum)

Alphabetisches Verzeichnis befindet sich auf Seite 292

Pflichtmodule | Required Modules

Modulbeschreibung

WZ1821: Natural Resources - Traits, Management and Theory of Sustainability | Natural Resources - Traits, Management and Theory of Sustainability

Natural Resources - Traits, Management, Theory of Sustainability

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 80	**Präsenzstunden:** 70

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Aufgrund des Pandemiegeschehens hat der/die Studierende auch die Möglichkeit, an einer beaufsichtigten elektronischen schriftlichen Fernprüfung (Aufsicht mit Proctorio, 90 min.) teilzunehmen (Onlineprüfung: WZ1821o). Diese schriftliche Prüfung wird zeitgleich parallel in Präsenz angeboten (WZ1821).

The intended learning outcomes as defined below require a differentiated way of examination. A written exam at the end of the semester will test whether the students sufficiently understand sustainability concepts and their connection to specific resources. As a midterm course achievement, external lecturer Dr. Savage offers the students topics for writing short reports about current global resource management problems as a homework, where they should show their ability to research and structure information and to identify crucial information gaps. Successful performance will improve the exam grade by 0.3.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
The module is intended to be a leitmotif during the first semester.

It consists of three basic units:

Unit 1 introduces the theory and the history of sustainability, supplemented by introducing interdisciplinary method knowledge.
Unit 2 introduces important natural resources, their specific traits in combination with sustainability challenges.
Unit 3 discusses case studies from interdisciplinary real-world-implementations.

Lecturers change during the semester. Each lecture is given by an expert in the specific field.

Lernergebnisse:
At the end of the module the students understand the most important theories and perceptions of sustainable resource management as well as traits and challenges connected with essential natural resources. Moreover, they are able to apply this knowledge for critically questioning given real-world situations. This comprises the ability to assess strengths and weaknesses of given problem solution approaches (as presented in the media or specialist literature), and to outline possible approaches if confronted with a resource management problem.

Lehr- und Lernmethoden:
Depending on each lecture's specific contents and due to the modules' interdisciplinary character, teaching methods combine classic presentations, blended learning and group work.

Medienform:
presentations, worksheets, simulation models

Literatur:
Recommended up-to-date readings are supplied by the specific lecturers

Modulverantwortliche(r):
Biber, Peter; Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Natural Resources - Traits, Management, Theory of Sustainability (Vorlesung, 5 SWS)
Biber P [L], Biber P, Grambow M, Häberle K, Kasperidus H, Knoke T, Kohlpaintner M, Kunkowski T, Menzel A, Pretzsch H, Savage C, Schad P, Teixeira Pinto L
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ1822: Introduction to Economics and Business Ethics | Introduction to Economics and Business Ethics

Modulbeschreibungsversion: Gültig ab Sommersemester 2015

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:**	**Präsenzstunden:**

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Current notice: Due to the continuing CoViD19-pandemic, the exam for this winter semester 2020/21 has been adjusted.
Students have the opportunity to participate in the written online examination, Online Proctored Exam (Onlineprüfungen: WZ1822o, WZ1822-1o und WZ1822-2o). These exams will parallely be held as regular written exam in person (WZ1822, WZ1822-1 und WZ1822-2).
The written examination (duration 90 min) assesses the students' understanding of the basic concepts of microeconomic theory (module part introduction to economics) and major business ethical concepts and issues. Furthermore, the examination tests students' ability to precisely describe solutions, achieve certain results and reproduce standard arguments within a limited amount of time.
A Mid-Term assignment (presentation) assesses the students' ability to present a new topic in a comprehensible manner. It will serve for grade improvement by 0.3 according to §6 (5) APSO.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:

Inhalt:
The module is an introduction to Business Ethics and Economics. Business ethics introduces the student to classical concepts of duty, consequentialism and virtues, in particular modern management virtues. The classical concepts are applied to corporate social responsibility and corporate governance. CSR and corporate governance will be discussed in the light of globalization, the financial crisis of 2008 and major corporate scandals.

The module part “Introduction to Economics” provides an introduction into microeconomic theory and the interaction between economics and the environment. Based on consumer and producer theory, we analyze the interactions of demand and supply on markets. We analyze economic reasons for market failure and use welfare economic concepts to evaluate market interventions. In the final part, we look at principles of intertemporal efficiency and an economic perspective of sustainability.

Lernergebnisse:
The major theoretical positions are reflected in public as well as private debates. Thus, understanding the structure of standard arguments contributes to the development of solution-oriented approach to ethical dilemmas and to the students’ rhetorical skills.
We will take hands on approach to CSR, focusing on Un Global Compact and specific CSR policies. This approach will prepare the student for practical challenges of implementing CSR policies. We will approach Corporate Governance in a similar manner, looking at cases of bad corporate governance, at codes of corporate governance and at the practical challenges of implementing stricter procedures in the organizations.
The lectures on power will introduce the students to a significant aspect of organizational interaction. We look at different ways to obtain power in an organizational context and we will investigate the opportunity for ethical action in a professional environment characterized by a more or less intensive power struggles. The analysis of consumer ethics will clarify why our environmentally damaging consumer habits are so difficult to change.
Students will learn about ways in which the economy and the environment are independent. They will understand the microeconomic theory of consumer and producer behaviour and reasons for market failure. They will be able to apply welfare economics to evaluate governmental market interventions. Furthermore, they will understand the temporal dimension of economic decisions and their implications for sustainability.

Lehr- und Lernmethoden:
2/3 lectures, 1/3 group work and student presentations

Medienform:

Literatur:
The texts will be provided on moodle

Modulverantwortliche(r):
PD. Dr. Thilo Glebe – Lehrstuhl für Volkswirtschaftslehre - Umweltökonomie und Agrarpolitik Alte Akademie 14; 85354 Freising; 08161-71-5965; glebe@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Introduction to Economics (WZ1822) (Vorlesung, 2 SWS)
Glebe T [L], Glebe T

(WZ1822) Business Ethics (Vorlesung, 2 SWS)
Thejls Ziegler M [L], Thejls Ziegler M
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ1823: Inventory Methods, Statistics and GIS | Inventory Methods, Statistics and GIS

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 110	**Präsenzstunden:** 70

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning success will be assessed by a written examination (duration 120 min) covering the knowledge and competence achieved in the three main branches of the module, namely GIS, Terrestrial Inventory Methods, Remote Sensing (RS), and Statistics. In GIS, a basic understanding of various GIS concepts and problem solution strategies is referred to.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
Implementation of basic concepts for acquisition, management, visualization of spatial data, and data evaluation as well as their inter-connection with tabular data from different source.
1. GIS: the focus is on the use of vector based GIS; the potentials of raster based GIS are demonstrated.
2. Terrestrial Inventory Methods: Introduction to sampling theory and application.
3. Remote Sensing (RS): Introduction to RS Principles: basic understanding of the physical background, on sensor concepts, evaluation strategies and spatial information extraction are elucidated.
4. Statistics in Resource Management: Justification of statistics, descriptive statistics and exploration: Frequencies and their graphical representation, distributions and their moments, testing hypotheses, regression analysis, post hoc tests, a priori contrasts, analysis of variance.

Lernergebnisse:
At the end of the courses on Inventory methods, GIS and Statistics the students are able to:

- select an appropriate GIS/Image Analysis program with respect to its intended field of application;
- apply a GeoInformatics tool (GIS and RS) to solve individual problems dealing with spatial information.
- understand the principles of sampling and how to assure the quality of a sample.
- understand the basic principles of remote sensing
- identify a geospatial problem and to decide on the appropriate RS system as well as on the data analysis strategy for the task to be supported. - understand data analysis as a support for their Master's Thesis, understanding the formulation of hypotheses, the connection of statistics to epistemology, their preconditions for proper application and interpretation of the results, applying important statistical techniques.

Lehr- und Lernmethoden:
The module includes lectures, exercises and accompanying examples.

Medienform:
Online material available at www.elearning.tum.de; Slides with lectures downloadable from a platform to be announced.

Literatur:
Environmental Systems Research Institute Inc.: Map Projections. Georeferencing spatial data, ESRI Press * Zeiler, M.: Modelling Our World. The ESRI Guide to Geodatabase Design, ESRI Press * Vienneau, A.: Using ArcCatalog, ESRI Press * Minami, M.;Sakala, M.;Wrightsell, J.: Using ArcMap, ESRI Press * Terrestrial Inventory Methods: Gregoire TG and Valentine HT (2008) Sampling strategies for natural resources and the environment. Boca Raton, Fla.; London, Chapman & Hall/CRC * Mandallaz D (2008) Sampling techniques for forest inventories. Applied Environmental Statistics. Chapman and Hall. 276 p * Introduction to Remote Sensing Principles: Richards, J.A., Jia, X.: Remote Sensing Digital Image Analysis - an introduction; Springer Press, Principles of Remote Sensing - an introductory textbook; Ed. L.L.F. Janssen, G.C. Huurneman, ITC educational textbook series; internet tutorials from ESA, DLR, NASA, CCRS, etc. * Statistics with Microsoft Excel (4th Edition) by Beverly Jean Dretzke (Paperback - June 20, 2008) *Discovering statistics using SPSS Field, Andy P. 2009

Modulverantwortliche(r):
Knoke, Thomas; Prof. Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Introduction to GIS (Vorlesung, 2 SWS)
Döllerer M

Statistics (Vorlesung, 1 SWS)
Knoke T

Inventory Methods (Vorlesung, 2 SWS)

Knoke T, Schneider T
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2713: Methods of Scientific Communication | Methods of Scientific Communication

Modulbeschreibungsversion: Gültig ab Sommersemester 2015

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The examination consists of a research paper which is the means to evaluate whether the students are able to apply the regulations of scientific writing in their own scientific paper. This assignment will be complemented by presentations of various lengths for the purpose of assessing the student's communication competency in presenting scholarly work to an audience.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
The students acquire detailed and differentiated knowledge about scientific communication including scientific writing, presentation and reflecting differentiated into the following topics:
- the communication process as two-way interaction; - group dynamics, dealing with difficult situations and facilitating conflict resolution in groups; - purpose of scientific writing; - procedure of scientific writing; - process of writing a scientific paper; - content details of the different chapters in a scientific paper; - looking for literature and data sources to write a scientific paper; - reflection of reviews; - English style of presentations; - how to express transition points; - how to describe tables, graphs and charts; - key characteristics of effective presentations; - the special features of scientific presentations; - the structural elements of a presentation; - vocal skills and body language, using and managing visual aids, persuasive language and delivery techniques;- dealing with nervousness, breaking the ice, handling questions and difficult situations; - different facilitation opportunities, challenges, and problems, verbal and nonverbal facilitation techniques, step-by-step facilitation processes and tools.

Lernergebnisse:
By the means of the module the students are able to:
- identify the elements of and barriers to communication; - understand the topic scientific writing;- apply the procedure of scientific writing;
- analyze other scientific papers;- apply literature sources; - create own scientific papers;- understand the importance of a good presentation; - recognize the features of an excellent presentation;- apply the key elements of presentation ; - analyze a presentation's situation (purpose/audience/roles); - create an own presentation (effectively plan, research and structure their presentation).

Lehr- und Lernmethoden:
Concerning teaching methods lecture and presentation parts provide theoretical foundations in both scientific writing and presenting. Exercises are introduced to the students who are supposed to finish them individually as homework. In group work as in reality concerning the process of scientific writing the students have to study specialist literature and data files which are the basis for writing the scientific paper as homework under time constraint. On basis of critique (review) by the lecturer they have to revise the scientific paper. As complement every student has to prepare and hold oral presentations in the seminar.

Medienform:
Power point presentation, black board, flip chart, pin board, lecture sheets, PDFs of scientific papers, PDFs of Guidelines.

Literatur:
Summary guideline "How to write a scientific paper" within the seminar.
Day, R.A.; Gastel, B.; 2012: How to write & publish a scientific paper. 7th edition, 2012, Cambridge University Press, pp. 300
Huss, J.; 2014: Schreiben und Präsentieren in den angewandten Naturwissenschaften. Ein Leitfaden. 2. Auflage. 256 Seiten. Verlag Kessel, Remagen-Oberwinter 2014. ISBN 978-3-941300-94-1.

Modulverantwortliche(r):
Apl.-Prof. Dr. Gabriele Weber-Blaschke – Lehrstuhl für Holzwissenschaft Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising; 08161/71- 5635; weber-blaschke@hfm.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Presenting (Seminar, 3 SWS)
Davies A

Scientific Writing (Seminar, 2 SWS)
Weber-Blaschke G, Hijazi O
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ1824: System Analysis and Introduction to Ecology | System Analysis and Introduction to Ecology

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 4	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Aufgrund des Pandemiegeschehens hat der/die Studierende auch die Möglichkeit, an einer beaufsichtigten elektronischen schriftlichen Fernprüfung (Aufsicht mit Proctorio, 90 min.) teilzunehmen (Onlineprüfung: WZ1824o). Diese schriftliche Prüfung wird zeitgleich parallel in Präsenz angeboten (WZ1824).

In a written exam (Klausur, duration 90 min), the students' understanding of important ecological concepts and ecosystem dynamics' patterns is assessed. Moreover, in the same exam, we test their understanding of system analysis methods and their ability to apply them in ecological and other contexts by correctly solving specific problems given in the questions.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
This module combines an introduction to ecology with an introduction to analyzing and modelling dynamic systems. As ecosystems are intrinsically dynamic, i.e. governed by feedback structures, understanding dynamic systems is a key qualification for understanding ecological theory. By examples from ecology but also from other fields (in which cases, however, transfers to ecological applications are always highlighted) formal key methods in structuring system knowledge, building computer models, and learning from such models are taught. An important insight to convey is the interdisciplinarity of dynamic systems and the related methods: Feedback structures found in ecosystems can often as well be found in social science or engineering contexts and vice versa.

Parallely, students get basic and advanced insights into fundamental elements of ecological concepts (e.g. modularity, unitarity, speciation, populations, metapopulations, competition, mutualism, ecosystems and their functions) and theory from the level of organisms to populations to species interactions up to the ecosystem level.

Lernergebnisse:
At the end of the module students understand essential elements of ecological theory and concepts. They remember important dynamic patterns and the ecological concepts behind. Moreover, they are able to apply key methods of system analysis to small and intermediate problems in ecology but also in other fields. The latter abilities include using causal loop diagrams and stock-and-flow diagrams for structuring information, understanding the basic mathematics behind dynamic models, being able to build small and intermediate simulation models, and to develop an understanding of the potential and limitations of computer simulations in general.

Lehr- und Lernmethoden:
Lecture providing theoretical foundations in ecology. Interactive lecture in System Analysis,with an individual workstation being available for each student. In the beginning, the group is closely guided through simple problems in order to develop routine in the methodological and technical basics while understanding fundamental dynamic processes from exponential growth and decay up to nth order delays. Along with their increasing skills, students are given the opportunity to work more independently, with individual guidance upon request, about problems like different approaches to sustainable harvest or overshoot and collapse systems. This concept allows the lecturer to adjust the share of frontal teaching and independent work to the group’s learning progress.

Medienform:
Reading material provided by lecturers, power point presentations, modelling software VENSIM PLE, example models

Literatur:
Begon, M., C. R. Townsend and J. L. Harper. 2006. Ecology: From Individuals to Ecosystems. Blackwell Publishing, Malden, MA.
Ford, A. Modeling the Environment. Island Press, 1999.
Sterman, J.D., Business Dynamics. McGraw-Hill Education, 2000.

Modulverantwortliche(r):
Biber, Peter; Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
System Analysis (Vorlesung, 2 SWS)
Biber P

Introduction into Ecology (Vorlesung, 2 SWS)

Meyer S [L], Meyer S, Heinen R, Weißer W, Mimet A, Achury Morales R, Biddick M, Novella Fernandez R
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

CLA11301: Präsentationstraining vor der Kamera | Presentation Training with Video Feedback

Modulbeschreibungsversion: Gültig ab Sommersemester 2015

Modulniveau: Bachelor/Master	**Sprache:** Deutsch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Unregelmäßig
Credits:* 1	**Gesamtstunden:** 30	**Eigenstudiums-stunden:** 7	**Präsenzstunden:** 23

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
In einer Präsentation (10-15 Min.) zeigen die Studierenden, dass sie sicher präsentieren können und wissen wie man anhand der Körpersprache überzeugt und wirkungsvoll zu einem Publikum spricht.

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:

Inhalt:
Im Workshop analysieren und üben Studierende, was eine gute Präsentation ausmacht und wie Körpertechnik, Körperhaltung und Sprache für einen bleibenden Eindruck eingesetzt werden können. Anhand von Videoanalysen erhalten die Studierenden konstruktives Feedback.

Präsentationen können auch in englischer Sprache gehalten werden.

Themen
- Körpersprachliche und stimmliche Wirkung
- Umgang mit Lampenfieber
- Einsatz von Medien
- Umgang mit Einwänden aus dem Publikum

Lernergebnisse:
Nach der Teilnahme sind die Studierenden in der Lage
- sicher und authentisch vor Publikum (und Kamera) aufzutreten

- körpersprachliche Wirkungselemente souverän einzusetzen
- Präsentationen publikumsorientiert und überzeugend zu gestalten

Lehr- und Lernmethoden:
Input, Präsentieren, Video-Feedback

Medienform:

Literatur:

Modulverantwortliche(r):
Bettina Hafner

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Brillant Präsentieren - live & vor der Webcam (Online Medientraining für deinen überzeugenden Auftritt) (Workshop, 1,5 SWS)
Bell I
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Wahlmodule | Elective Courses

Vertiefungsbereiche | Fields of Specialization

Environmental Economics and Policy | Environmental Economics and Policy

Modulbeschreibung

WI000286: Environmental and Natural Resource Economics | Environmental and Natural Resource Economics

Modulbeschreibungsversion: Gültig ab Sommersemester 2017

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning success will be assessed by a written exam (120 minutes)..
By answering the questions students show that they are able to understand the economic view of environmental and resource problems. Furthermore students show that they are able to compare and evaluate alternative economic instruments (e.g. taxes, emission permits, payments for environmental services). They show their ability to apply environmental policy instruments and valuation methods to specific problems. Finally students demonstrate that they are able to conduct and interpret economic cost-benefit analyses.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
A basic knowledge in Microeconomic theory is recommended

Inhalt:
a) Economic growth and the environment
b) Economic analysis of environmental problems
c) Role of institutions and liability rules
d) Analysis of environmental economic instruments

- Command and control measures
- Pollution taxes
- Emission trading
- Payments for environmental services
e) Valuation methods for environmental goods
f) Cost-benefit analysis.

Lernergebnisse:
At the end of the module the students are able to understand the economic view of environmental and resource problems. They know alternative economic instruments, e.g. taxes, emission permits, payments for environmental services and how they work and are able to compare them regarding their economic efficiency. They know and can apply specific valuation methods to attach a monetary value to environmental effects and conduct and interpret economic cost-benefit analyses.

Lehr- und Lernmethoden:
The module will be held in the form of lectures which are partially combined with group discussions and exercises. The main learning objective is here to understand the economics of environmental policy. Lectures are a format suitable to convey theoretical knowledge about the welfare implications of policy interventions. Integrated exercises will help students to apply acquired knowledge to concrete problems and derive economically sound answers.

Medienform:
PowerPoint

Literatur:
A digital reader consisting of various textbook chapters and journal articles will be put on Moodle for each chapter of the course.

Jaeger, W.K. (2005): Environmental Economics. Island Press.
Mankiw, N.G. and M.P. Taylor (2011): Microeconomics. 2nd Edition. South Western.
Perman, R., Y. Ma, J. McGilvray, M. Common (2003): Natural Resource and Environmental Economics. 3rd Edition. Pearson Education Limited.
Tietenberg, T. and L. Lewis (2010): Environmental Economics & Policy. Prentice Hall.

Modulverantwortliche(r):
Glebe, Thilo; PD Dr. habil.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Environmental and Natural Resource Economics (WI000286) (Vorlesung mit integrierten Übungen, 4 SWS)
Glebe T

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ1590: Climate Change Economics | Climate Change Economics

Modulbeschreibungsversion: Gültig ab Wintersemester 2014/15

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 60	**Präsenzstunden:** 90

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
There will be a written exam (Klausur) of 90 minutes at the end of the semester. The students will be asked to demonstrate, within the stipulated amount of time using predefined methods and resources, their ability to outline the challenges climate change poses to regulators, propose pragmatic solutions and strategies as well as ways of implementing them. This would be based on the competences acquired from the relevant literature of economic modeling, theories of climate change and their understanding from the course content. The written exam is an appropriate assessment method to evaluate the degree to which the students understand the theoretical framework of climate change implications as well as provides an opportunity for them to put forward arguments based on existing theory.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge:
• Micro Economics (Welfare Economics)
• Environmental Economics
• Resource Economics

Inhalt:
This course covers the trends in current and future climate change and their effects on economic and social outcomes.

The lectures are divided into ten sessions:
1. Introduction to the Basic Science of Climate Change
- The students will learn about the scientific themes of global climate change and the economic dimension of the phenomenon.

2. Basic Economics
- The students will learn how a market economy can be efficient and socially optimal as well as about the prospects of externality.
3. Optimal Emission Levels
- The students will learn of the optimal abatement path and its uncertainty with respect to damages as well as Integrated Assessment Models (IAMs).
4. Intra-generational equity in climate policy
- The students will learn about how to account for equity across space (intergenerational equity) when deriving optimal emission levels.
5. International Environmental Agreements
- The students will learn about the dynamics behind common strategies towards achieving some form of optimal emission level.
6. Policy Instruments
- The students will learn about diverse instruments such as quality-based approach and Pigouvian Tax.
7. Regulation via Prices vs. Quantities
- The students will learn what circumstances will a regulator prefer prices over quantities and vice versa.
8. Credit-based Mechanisms
- The students will learn about how to deal with countries that do not want to commit, but have a high potential for low-cost reductions.
9. German Climate Policy
- The students will learn about German Climate Action - strategies and policies
10. European Union Emission Trading Scheme - EU ETS

Lernergebnisse:
After successfully completing the module, students are able to:
• Evaluate and formulate economic models related to climate change.
• Apply theoretical model to climate change regulations as well as policies that affect emission levels.
• Analyze the complexity, uncertainty and possibilities associated with optimal emission level.
• Apply appropriate instruments for optimal emission level that are efficient and cost-effective.
• Understand climate negotiations (club) and climate action strategies are currently being implemented.

Lehr- und Lernmethoden:
The course mainly consists of lectures (4 SWS). The lecture will provide a foundation upon which to build the ensuing discussions on climate change issues from an economic perspective. The content of the module is expected to be transferred to the students in an interactive learning manner were, among others, emission reduction instruments are scrutinized. This encourages the students to independently and self-reliantly study the literature guided by a structured framework.

Medienform:
PowerPoint, flipchart, internet portals, online reports etc.

Literatur:
Bréchet, T., & Eyckmans, J. (2009). Coalition theory and integrated assessment Modelling: Lessons for climate governance. Global Environmental Commons: Analytical and Political Challenges in Building Governance Mechanisms.
Rohling, M., & Ohndorf, M. (2012). Prices vs. quantities with fiscal cushioning. Resource and Energy Economics, 34(2), 169-187.
MacKenzie, I. A., & Ohndorf, M. (2012). Optimal monitoring of credit-based emissions trading under asymmetric information. Journal of regulatory economics, 42(2), 180-203.
Hake, J. F., Fischer, W., Venghaus, S., & Weckenbrock, C. (2015). The German Energiewende–history and status quo. Energy, 92, 532-546.
Climate Action Plan 2050 Principles and goals of the German government's climate policy. https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/klimaschutzplan_2050_en_bf.pdf
EU ETS Handbook. https://ec.europa.eu/clima/sites/clima/files/docs/ets_handbook_en.pdf

Modulverantwortliche(r):
Sauer, Johannes; Prof. Dr. agr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Climate Change Economics (WZ1590) (Vorlesung, 4 SWS)
Sauer J [L], Canessa C, Frick F
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2936: Sustainable and Environmental Regulations | Sustainable and Environmental Regulations

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Successful completion of the course will be based in both seminars on the quality of the presentation in the seminar and a written executive summary on the topic of the presentation (course 1: presentation of around 30 min; executive summary of 5 pages; course 2: presentation of around 30 min; executive summary of around 3 pages).
The presentation is a means to measure the students' ability to understand the context and complexity of sustainable development in different countries and formal impact assessment procedures by preparing and delivering a well-researched and instructive oral presentation on a certain facet. An accompanying executive summary of major findings and conclusions indicates the capacity of the students to summarise the presentation in a clear and concise manner. In addition, the students are expected to show their oral communication skills by responding competently to questions and comments by the audience as well as by contributing to class discussions. Depending on the number of seminar participants, the presentation may be given either individually or in groups.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Class discussion is a core element of the seminars. Therefore, students are expected to take part and contribute to the discussions. Recommended Prerequisites: Module WZ2713 Methods of Scientific Communication.

Inhalt:
Course 1 "Sustainable Development and Regime Type": The seminar introduces both the theoretical debate on sustainable development and the discussion about the role political regime

type (democracy, autocracy, hybrid regime) play for the sustainability performance of a country. What are the goals of "sustainable development"? Which policy areas have a strong relationship to sustainability? To what extent do countries differ in their "sustainability profile" in various policy areas? What influence does the regime type play in this regard?
The seminar investigates these theoretical and empirical issues in the context of pressing future challenges, such as rising government debt in many countries, growing global competition for innovation, and intensifying global environmental degradation and resource scarcity. The seminar will focus on discussing theoretical approaches to current "sustainability debates" and considering what defines generationally just behavior. In addition, empirically based comparisons of countries under different political leadership will be made looking at several sustainability areas (e.g. economic, financial, educational, research, family, pension, environmental and energy policy).

Course 2 "Methods of Environmental Assessment": The seminar introduces the methodology of EIA and SEA as worldwide established instruments for assisting sound environmental management. Being integral parts of spatial planning and decision-making, the assessment procedures integrate biophysical and socioeconomic information to predict and evaluate the environmental consequences of proposed projects, plans and policies and to suggest means to avoid or mitigate significant impacts. The seminar gives an overview of the concepts, methods, procedural elements of EIA and SEA and stimulates discussion on key aspects of environmental assessment.

Lernergebnisse:
At the conclusion of the module, the students will have basic knowledge on sustainable development, its theoretical and empirical implications and its most important policy fields. The students understand the structure and the functioning of different political regimes and are able to evaluate their impact on the sustainable development of a country. Furthermore, the students are able to appreciate the purpose of EIA and SEA and their role in the decision-making process; explain the major principles and procedural steps of EIA and SEA; know options for estimating environmental impacts; reflect critically on the strength and limitations of the instruments; communicate findings in class and comment on the work of fellow students.

Lehr- und Lernmethoden:
In the SDRT seminar lectures, presentations and discussions provide students with a basic knowledge on sustainable development and political regime type and allows them to evaluate the performance of different states with regard to their sustainability performance.

In the MEA seminar, presentations by students and the lecturers provide the basis for exploring and discussing the concepts, methodology, current practice and potentials of environmental assessment. Class discussions engage students in critical thinking and analysing the scope and limitations of the presented material.

Medienform:
The module includes lectures, presentations, class discussions, (small group) exercises and assigned readings.

Literatur:
Wintrobe, R. (2000): The Political Economy of Dictatorship, Cambridge University Press, Cambridge; Tremmel, J. (2006): Handbook of intergenerational justice, Edward Elgar, Cheltenham; Glasson, J., Therivel, R. & A. Chadwick (2019): Introduction to Environmental Impact Assessment. 5th edition. Routledge, London and New York: 394 pages; Sadler, B., Aschemann, R., Dusik, J, Fischer, T.B., Partidário, M.R. & R. Verheem (2011): Handbook of Strategic Environmental Assessment. Earthscan, London, Washington, DC. Additional material will be provided.

Modulverantwortliche(r):
Augenstein, Isabel; Dr. agr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Methods of Environmental Assessment (Seminar, 2 SWS)
Augenstein I

(WZ2936) Sustainable Development and Regime Type (Seminar, 2 SWS)
Wurster S (Mohammed N, Schmid H)
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Management and Protection of Forest Ecosystems | Management and Protection of Forest Ecosystems

Modulbeschreibung

WZ4161: Forest Management | Forest Management

Modulbeschreibungsversion: Gültig ab Sommersemester 2022

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The module integrates different scientific and management methods with the objective to develop concepts for the sustainable management of forest. Forest managers must understand complex content and be able to explain it to a critical audience. The learning outcome will be assessed by an oral exam (30 minutes) covering the whole outcomes of the module.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None.

Inhalt:
1. Definition of forest and forest ecosystem
2. Overview of forestry on global, regional and local scales
3. Introduction into objectives and methods of forest ecosystem management and forest management planning
4. Demonstration of forest decision support systems and multiple-objective optimization
5. Overview of silvicultural techniques
6. Basic Knowledge of Forest economics
7. Demonstration of examples in lowland and mountain forest management.

Lernergebnisse:
At the end of the module the students are able to:

- understand different concepts of forest management
- understand different demands in forest management
- apply means of linear programming to harmonize different measures
- apply decision support systems
- evaluate different forest management measures.

Lehr- und Lernmethoden:
The module is separated into lectures and exercises. Lectures providing the theoretical foundations and concepts in Forest Management.
Exercises are done in supervised groups in the field.

Medienform:
PowerPoint presentations, additional reading material, software application.

Literatur:
FAO (2018): State of the World's Forests; FAO (2016): Global Forest Resources Assessment 2015.

Modulverantwortliche(r):
Felbermeier, Bernhard; Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Forest Ecosystem Management (Vorlesung, 2 SWS)
Felbermeier B [L], Annighöfer P, Felbermeier B

Forest Management Planning (Übung, 3,5 SWS)
Knoke T, Bödeker K, Döllerer M, Gang B, Kienlein S, Pintado K
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2716: Forest Growth and Forest Operations | Forest Growth and Forest Operations

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning success of the module Forest Growth and Forest Operations will be assessed by a written examination of 90 minutes. This is due to the fact that biometric topics, growth processes and analyses as well asthe forest growth modelling part of the lecture can be presented best in a written formby drawings, figures, calculation schemes, etc. For example the description of biological processes and growth cycles in forest growth simulators can best be explained and depicted by graphical representations.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in biology and forest science.

Inhalt:
The part Forest Growth deals with objectives and methods of forest growth and yield science. First, as fundamental topic, principal factors of the organic production of forest stands based on the driving forces (climate, water, nutrients) are shown and explained. In a next step growth and yield is analyzed more closely as part of the total production of plant communities. This leads to principles of tree shape development, tree growth and carbon dynamics in general. From individual tree growth the course proceeds to structure and development of whole forest stands. Both previous subjects provide the basic knowledge for understanding the effect of silvicultural treatment on quantitatively measured growth and yield characteristics. Growth trends, productivity and carbon dynamics of the main tree species in Central Europe are presented. Analyses of stand structure, growth and yield in the view of climate change are discussed. Different types of forest growth models on tree, stand and forest enterprise levels are introduced. The part Forest Operations can be divided in 5 topics: (1) Overview of mechanized harvesting (methods and

most common systems), (2) Environmentally sound resource road planning and construction, (3) Assessing the environmental impacts of forest operations on forest stands and soils, (4) Means of eco-efficient wood transportation from the forest to the mill and (5) Current developments in small-scale forest operations.

Lernergebnisse:
On successful completion of the module, students are able to
- Understand the environmental factors influencing the forest stand production
- Describe the effects of silvicultural treatment on quantitatively measured growth and yield characteristics
- Understand the principles of growth models
- Analyze and evaluate the impact of environmental changes on tree and stand growth
- Create possible silvicultural measures to mitigate negative effects of environmental changes on forest stand growth
- Understand and evaluate the impact of biotic and abiotic factors on growth, vitality and stability of individual trees and forest stands
- Understand the fundamentals of sound resource road planning and construction
- Describe the links between mechanized harvesting and potential stand and soil damages
- Evaluate the productivity and carbon footprint of different harvesting systems.

Lehr- und Lernmethoden:
Lectures and presentations, field trip (optional).

Medienform:
Lectures and presentations (pdfs).

Literatur:
FOREST GROWTH: Pretzsch, H., (2009): Forest Dynamics, Growth and Yield. Springer Verlag, Berlin, 664 S. 2009 published as Hardcover(ISBN 978-3-540-88306-7) 2010 published as paperback (ISBN 978-3-642-14861-3) FOREST OPERATIONS: Bowers, S. 2012. Designing woodland roads. Oregon State University. EC 1137. 21 pp. Dykstra, D. P. and Heinrich, R. 1996. FAO Model code of forest harvesting practice. 85 pp. Enters, D., Applegate, G.B., Kho, P. C.S., and Man, G. (Eds.) 2002. Applying reduced impact logging to advance sustainable forest management. FAO. Heinrich, R. Recent developments on environmentally friendly forest road construction and wood transportation in mountainous forests. Rummer, B. 2009. New technology in forest operations. www.forestlandowners.com. 3 pp. Sutherland, B.J. 2003. Preventing soil compaction and rutting in the boreal forest of western Canada. FERIC. 53 pp.

Modulverantwortliche(r):
Rötzer, Thomas; Apl. Prof. Dr. agr. habil.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Low Impact Forest Operations Technology (Exkursion, ,5 SWS)

Bauer E, Engler B

Low Impact Forest Operations (Vorlesung, 1,5 SWS)
Bauer E, Engler B

Forest Growth (Vorlesung, 2 SWS)
Pretzsch H, Rötzer T
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2717: Genetic Resources Management and Forest Protection | Genetic Resources Management and Forest Protection

Modulbeschreibungsversion: Gültig ab Wintersemester 2020/21

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning outcome will be assessed by a written exam (duration 60 min) where the student have to analyze the risk of given pest and abiotic hazard-scenarios and to develop adequate disturbance management strategies. Furthermore, they have to analyze a genetic diversity study from a plant, animal or fungus species and develop a long-term genetic management strategy. In this way, the students can demonstrate that they have obtained the ability to use their knowledge in real world management situations.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in biology and forest science

Inhalt:
Part I Genetic Resources Management – Schaefer/Benz
1. Introduction: DNA, genetic code, genes, alleles, genomes, speciation
2. Basics of Population Genetics
3. Genetic variation in forest ecosystems
4. Tree breeding
5. Genetic conservation & sampling strategies
6. GRM in mountain ecosystems
7. GRM in the Tropics
8. GRM in the dry zones
9. Sustainable management strategies
10. Fungi – The Good, the Bad, and the Ugly
11. The genetic treasure trove of fungi

Part II Disturbance ecology & management– Seidl/Seibold
1. Disturbance ecology 101 (R. Seidl)
2. The role of disturbances in forest ecosystem dynamics (R. Seidl)
3. Forest protection strategies in the course of time (S. Seibold)
4. Wind (R. Seidl)
5. Snow and ice (R. Seidl)
6. Fire (R. Seidl)
7. Drought (R. Seidl)
8. Functional roles of insects in forest ecosystems (S. Seibold)
9. Bark beetles – ecology (S. Seibold)
10. Bark beetles – management and impacts (S. Seibold)
11. Defoliators (S. Seibold)
12. Aphids, adelgids and others (S. Seibold)
13. Deadwood-inhabiting insects (S. Seibold)
14. Principles of disturbance management (R. Seidl)

Lernergebnisse:
On successful completion of the module, students are able to
- assess genetic diversity patterns in natural populations of different groups of organisms (mammals, birds, plants, fungi)
- understand the importance of maximizing genetic diversity
- understand the impact of biotic and abiotic factors on vitality and stability of individual trees and forests;
- understand the impact of fungal pathogens and insects on trees;
- apply their ecological knowledge to minimize and forecast the risk of damages by fungal pathogens;
- U explain the most important abiotic and biotic causes of tree death in forest ecosystems
- ccharacterize forest disturbance regimes
- understand the different roles that disturbances play in forest ecosystems
- kexplain how plants adapt to different disturbance agents
- develop different disturbance management strategies.

Lehr- und Lernmethoden:
Lectures and presentations: provide the theoretical population genetics and ecological background to understand the role of genetic diversity in general and the role of disturbance at population level and beyond.
Group work: will be used to learn how to assess and interpret genetic diversity patterns in various real world examples and to practice risk forecasting in disturbance management or develop disturbance management strategies.
Field trip (optional): to help understand the role of disturbance and genetic diversity in a real Bavarian forest setting.

Medienform:
lectures and presentations (pdfs)

Literatur:
Frankham, et al. 2017, Genetic Management of Fragmented Animal and Plant Populations, Oxford University Press; Allendorf et al. 2013, Conservation and the Genetics of Populations, Wiley-Blackwell; Agrios, G.N. 2005, Plant Pathology, 5th edition. Elsevier Academic Press, Oxford; Speight, M.R. & Wylie, F.R., 2001: Insect pests in tropical forestry. CABI publishing; Ruppert, E.E. & Barnes, R.D., 1993: Invertebrate Zoology 6th edition (Chapter 16 insects; p 825-862)

Modulverantwortliche(r):
Schäfer, Hanno; Prof. Dr. rer. nat.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Genetic Resource Management (Vorlesung, 2 SWS)
Benz J, Schäfer H

Disturbance ecology and management (Vorlesung, 2 SWS)
Seidl R [L], Seidl R, Seibold S
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4082: Plantation Forestry and Agroforestry | Plantation Forestry and Agroforestry

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Aufgrund des Pandemiegeschehens wird die alternative Prüfungsform Klausur, schriftlich (90 min, WZ4082o) angeboten.

The learning outcomes are assessed by an oral examination. Based on specific problem statements the students have to demonstrate their ability to analyze and assess the situation, to understand the origin of the problem and to propose solutions adapted from the methodologies and techniques procured in the course.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
none

Inhalt:
Plantation forestry: Background, Definitions, Plantations in the Context of International Forest Policy, Plantation Forestry Purposes, Plantation Silviculture, Management and Economics; Agroforestry (AF): Introduction (global land-use problems, definitions, terminology), Traditional AF Systems, Environmental, economic and socio-cultural aspects of AF, Interactions in AF systems, Important tree groups in AF (NFT´s, MPT´s, Palms), Planning in AF, Legal aspects
Forest Management for Carbon Sequestration: Role of forests in the global carbon cycle, Possible impacts of climate change on forests, International climate policy, Forest in the Kyoto Protocol (KP), Flexible mechanisms of the KP, REDD and REDD+, Forest management options, Modelling forest sequestration with CO2FIX, Case studies.

Lernergebnisse:
Students will be able to
- understand and evaluate the major issues of plantations in the context of international forest policy,
- explain the fundamental purposes of Plantation Forestry,
- properly deploy the essential techniques of Plantation Silviculture, e.g. for establishment, tending and maintenance
- critically examine plantation projects (management, work volume, economic results).
- understand the fundamental principles and practices of agroforestry land use,
- analyze the interactions among different components of an AF system,
- assess the ecological and economic effects of AF-systems and develop adequate management options,
- address problems in the context of rural development and identify AF-based solutions
- understand the role of forests and forest management activities in the global C-cycle,
- assess forest management options for different purposes within the framework of the international climate policy,
- identify and develop concepts for mitigation projects.

Lehr- und Lernmethoden:
Knowledge and skills are imparted by lectures, group discussions, presentation of case studies and small exercises; the learning methods are learning, reviewing scientific articles, and research reference articles. The lectures will provide theories and basic reference materials which will be deepened and proved by reviewing articles. The achieved skills will be used to develop and discuss solutions for specified problems.

Medienform:
The module includes lectures - providing the theoretical foundations, discussions and small exercises.

Literatur:
ABARE - JaakoPöyry (1999): Global Outlook for Plantations. Australian Bureau of Agricultural and Resource Economics (ABARE) Research Report 99.9, www.abare.gov.au. Evans, J., Turnbull, J. W. (2004): Plantation forestry in the tropics. FAO, (1998): FRA 2000 - Terms and definitions. Forest Resources Assessment Programme, Working Paper 1. FAO (2001): Global Forest Resources Assessment 2000. FAO Forestry Paper 140. Pandey, D. and Ball, J. (1998): The role of industrial plantations in future global fibre supplies. Unasylva 193, Vol. 49, 37 - 43. Sawyer, J., (1993): Plantations in the Tropics. Smith, D.M., Larson, B.C.,Kelty, M.J. and Ashton, P.M.S. (1997): The Practice of Silviculture: Applied Forest Ecology. Smith, J. (2002): Afforestation and reforestation in the clean development mechanism of the Kyoto protocol: implications for forests and forest people. Int. J. Global Environmental Issues 2 (3/4): 322-343. Shepherd, K.R. (1986): Plantation Silviculture. West, P. W. (2006): Growing Plantation Forests. Ashton, M.S. and Montagnini, F. (2000): The silvicultural Basis for Agroforestry Systems. Agroforesty: Principles and Practice: Special issue of Forest Ecology and Management, 45 (1991). Nair, P.K.R. (2012): Agroforestry, the future of global land use. Atangana et al. (2014): Tropical Agroforestry. Springer Verlag

Modulverantwortliche(r):
Annighöfer, Peter; Prof. Dr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Plantation Forestry (Vorlesung, 2 SWS)
Annighöfer P [L], Annighöfer P, Günter S

Agroforestry and Forest Management for Carbon Sequestration (Vorlesung, 2 SWS)
Annighöfer P [L], Annighöfer P, Thom D
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Wildlife and Protected Area Management | Wildlife and Protected Area Management

Modulbeschreibung

WZ4197: Protected Areas Biodiversity and Management | Protected Areas Biodiversity and Management

Modulbeschreibungsversion: Gültig ab Sommersemester 2020

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Final oral examination of 20 minutes in the field of protected areas biodiversity and its management to examine whether the students have understood the problematic of securing biodiversity in protected areas and are able to verify conservation measurements.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Successful completion of the 1st semester of the Master Program Sustainable Resource Management is recommended

Inhalt:
Biodiversity and protected areas: A worldwide survey on ecozones and altitudinal belts of the word as carriers of natural biodiversity; protection of biological units; IUCN protected areas classification, the European FFH Directive as an example of a continent-wide tool for nature protection.

Habitat analysis and management: Habitat types, tools for protecting habitats, design of management plans, visitor management, best practice examples in sustainable biodiversity and habitat protection.

Lernergebnisse:
On successful completion of the module students are able to:
- to put ecosystems and its utilisation options as well as its threats into a global perspective

- give clear options for further management, both regarding utilisation and protection

Lehr- und Lernmethoden:
Lecture, case studies, practical experiments / demonstrations, discussions.

Medienform:
PowerPoint Presentation.

Literatur:
Jürgen Schultz (2005): The Ecozones of the World: Ecological Divisions of the Geosphere. Springer, Berlin. 459p.

Modulverantwortliche(r):
Prof. Dr. Ralph Kühn; kuehn@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Biodiversity in Protected Areas (Vorlesung, 2 SWS)
Kühn R [L], Gula R, Rödl T

Protected Area Management (Vorlesung, 2 SWS)
Kühn R [L], Gula R, Rödl T
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4198: Wildlife Management and Wildlife-Human Interactions | Wildlife Management and Wildlife-Human Interactions

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Written assignment (ca. 15 pages) requiring review of literature, synthesis and integration of key concepts and findings from the literature to develop a coherent research proposal that clearly demonstrates knowledge in the field of species management and conservation strategies and of human dimensions as a research and applied field of study. Expected to read in advance where possible assigned readings so to be prepared for course lectures.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
This lecture combines contents of Wildlife Management and Wildlife Human Interactions. The key aspects are: 1) Principles of Wildlife Management & Wildlife Science, 2) Planning tools, 3) Case study: Strategic planning, 4) Conflicting views in WMT with case studies, 5) Basic Concepts in Ecology, 6) Reintroductions studies, 7) Global threats to Conservation, 8) Nature of human dimensions (HD) from a research perspective through various examples 9) Nature of various wildlife-human interactions from different perspectives, 10) Nature of public involvement and HD as an applied approach 11) Types of conflict, levels of planning and how to work with people toward solutions, 12) Understanding decision-making processes.

Lernergebnisse:
After the course students are able to: understand important ecological concepts in wildlife management; understand the importance of the human dimension in wildlife management; analyze a conservation strategy for a species; apply wildlife management plans; evaluate species

and protected area management plans; understand the importance and nature of objectivity in conducting research and being a human dimension researcher; develop the ability to synthesize relevant literature pertinent to a research problem; organize ideas effectively and communicate these in a well-organized and developed written proposal.

Lehr- und Lernmethoden:
Lecture, video, group exercises, discussions

Medienform:
lecture notes, flip-chart/board, hand-outs, additional reading material

Literatur:
Sinclair et al. 2006, Wildlife Ecology, Conservation, and Management, ISBN 1-4051-0737-5 ; Krausman 2002, Wildlife Management, ISBN 0-1328-0850-1; Pullin 2002, Conservation Biology, ISBN 0-521-64482-8

Modulverantwortliche(r):
Kühn, Ralph; Apl. Prof. Dr. agr. habil.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Wildlife-Human Interactions (Seminar, 2 SWS)
Kühn R [L], Bath A

Wildlife Management (Vorlesung, 2 SWS)
Kühn R [L], Rödl T
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ6432: Wildlife and Conservation Biology | Wildlife and Conservation Biology

Modulbeschreibungsversion: Gültig ab Sommersemester 2020

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 75	**Präsenzstunden:** 75

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The examination consists of an oral examination (30 min). The examination means to measure the student's ability to assess anthropogenic influence on Biodiversty, to explain factors affecting Wildlife, to recall methods in Conservation Biology and applied Genetics and to evaluate Conservation Biology concepts. In the written examination students demonstrate by answering questions under time pressure and without helping material their theoretical and practical knowledge about Wildlife and Conservation Biology. For answering the questions, the students require their own wording. In the practical excercise the students present a case study and design a own research project proposal to practice their scientific communication skills and to transfer the theoretical knowledge to practical projects.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Interest in Wildlife Conservation Biology and Nature Conservation. Basic background in Biology

Inhalt:
The module combines the theoretical background and the practical implementation of Wildlife Conservation Biology, Conservation Genetics and Nature Conservation. The key aspects are:
1. Scope and tasks of Conservation Biology and applied Genetics
2. Biodiversity, Ecosystems, Ecosystem Services and Green Bankiing
3. Factors affecting terrestrial and aquatic Biodiversty
4. Methods in Wildlife Conservation Biology and applied Genetics 5. Conservation Biology concepts and strategies for natural population using international examples
6. Case studies and applied Nature Conservation, from theory to praxis

Lernergebnisse:
At the end of the module students understand the importance of Biodiverstiy of terrestial resources and its interaction with human dimensions. They are able to apply and to evaluate Conservation Biology methods and strategies based upon an interdisciplinary understanding of species biology, conservation biology and applied genetics. In addition, students are able to integrate interdisciplinary knowledge into applied conservation management on a regional and international scale. They have an overview of applied interdisciplinary Nature Conservation management and are able to evaluate sustainable resource management strategies.

Lehr- und Lernmethoden:
The module combines the lecture "Wildlife and Conservation Biology" with an accompanying practical excercise " Case Studies in Nature Conservation". The lecture contents will be presented using lectures based on power-point presentation and group work in order to combine activating teaching methods with classic presentation techniques. In the accompanying practical excercise, the students will apply the gained theoretical knowledge by conducting case studies (research programs), and presenting own concepts of research project in various content in the field of Wildlife Conservation Biology and Nature Conservation. Here the students learn to independently screen the respective literature in this field and learn methods in science communication.

Medienform:
Form of presentation: lecture, case study, movie segment and practical excercise
material: lecture notes, flip-chart/board, plus different materials for methodological/technical training

Literatur:
1. Primack (2014) Essentials of Conservation Biology 2. Frankham (2010) Introduction to Conservation Genetics 3. Sutherland (2009) Conservation Science and Action

Modulverantwortliche(r):
Kühn, Ralph; Apl. Prof. Dr. agr. habil.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Conservation Biology and Applied Genetics (Vorlesung, 2 SWS)
Kühn R

Case Studies in Nature Conservation (Übung, 3 SWS)
Kühn R, Stoeckle B
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4189: Fisheries and Aquatic Conservation | Fisheries and Aquatic Conservation

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Current information regarding the limited activities with physical presence due to the CoViD19-pandemic:
In case the framework requirements (hygienie, distance rules etc.) for examinations with physical presence are not met, the planned examination format can be changed to a digital (remote) examination according to §13a APSO. The decision on this change will be communicated as soon as possible, however latest 14 days before the actual examination date, by the responsible examiner in coordination with the examinations board.

The examination consists of a 60 min. written exam (Klausur). In addition, the students need to prepare a 10-15 min. presentation in the practical exercise. Gradings from the examination and the presentation are weighed in the ratio 2:1. The examination means to measure the student’s ability to assess anthropogenic influence on aquatic ecosystem functioning, evaluate the socioeconomic importance of fisheries and aquaculture , explain factors affecting susceptibility to and recovery from overexpoitation and recall fisheries management tools for wild populations as well as of the underlying biological principles such as fish population dynamics. In the written examination students demonstrate by answering questions under time pressure and without helping material their theoretical and practical (e.g. application of methods) knowledge about fisheries management. For answering the questions, the students require their own wording.
In the practical excercise the students prepare a presentation in form of a broschure, poster, video or podcast. For the presentation, the student is expected to demonstrate that he or she is capable of preparing a certain topic within a given time frame in such a way as to present or report it in a clear and comprehensible manner to specific target audiences in the context of fisheries and aquatic conservation.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Interest in aquatic biology, social sciences, conservation biology and management; this course can be selected
independently from other courses in the fields of Fish Biology and Limnology at TUM

Inhalt:
The module combines the theoretical background and the practical implementation of fisheries management and aquatic conservation. The key aspects are:
1. Introduction to fish, shellfish and fisheries management,
2. The socioeconomic importance of fisheries and aquaculture,
3. The functioning of aquatic ecosystems and the impacts of fisheries on aquatic ecosystem health,
4.Factors affecting susceptibility to and recovery from overexploitation,
5. Fisheries Management Tools for wild populations,
6. Aquaculture,
7. Aquatic Biodiversity Conservation,
8. Case study and knowledge transfer/communication excercise

Lernergebnisse:
At the end of the module students understand the importance of aquatic resources for mankind and the variables which influence ecosystem functions as well as the principles of aquatic biodiversity conservation. They are able to analyze the effects of natural and man-made disturbances in aquatic ecosystems (e.g. overexploitation) based upon an interdisciplinary understanding of methodological aquatic
and fisheries biology, human dimensions, socioeconomic factors and management skills. In addition, students are able to objectively integrate knowledge from different disciplines (e.g. fish biology, conservation biology, commercial fishing techniques, aquatic habitat assessment and management) to evaluate sustainable resource management.

Lehr- und Lernmethoden:
The module combines a lecture "Fisheries Management" with an accompanying practical excercise " Applied Aquatic Conservation". The lecture contents will be presented using lectures based on power-point presentation, group work and interactive role plays in order to combine activating teaching methods with classic presentation techniques. In the accompanying practical excercise to the lecture the students will apply the gained theoretical knowledge by conducting case studies or participating research experiments with various content in the field of freshwater ecology and aquatic conservation. The content of the practical work is incorporated into running research projects at the chair (e.g. habitat restoration, artificial breeding programmes, habitat assessment, conservation genetics). Additionally, the students learn to independently screen the respective literature in this field and learn methods in science communication.

Medienform:
Form of presentation: lecture, case study, movie segment and practical excercise

material: lecture notes, flip-chart/board, plus different materials for methodological/technical training

Literatur:
1. King (2007) Fisheries Biology, Assessment and Management
2. Helfman (2007) Fish Conservation: A guide to understanding and restoring global aquatic biodiversity and fishery
resources
3. Moyle & Cech (2004) Fishes An introduction to Ichtyology
4. Primack (2008) A primer of conservation biology

Modulverantwortliche(r):
Geist, Jürgen; Prof. Dr. rer. nat.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Fisheries Management (Vorlesung, 2 SWS)
Geist J

Applied Aquatic Conservation (Übung, 2 SWS)
Geist J [L], Bayerl H, Geist J, Pander J, Stoeckle B, Zingraff-Hamed A
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Landscape Management | Landscape Management

Modulbeschreibung

WZ4201: Vegetation Ecology and Geographical Information Systems | Vegetation Ecology and Geographical Information Systems

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Aufgrund des Pandemiegeschehens wird die alternative Prüfungsform unbeaufsichtigte elektronische Fernprüfung
(90 min. Moodle-Upload, Online-Prüfung: WZ4201o) angeboten.

A written exam of 90 minutes assesses whether the students understand the basic concepts of spatial data analysis as well as vegetation ecology with respect to manage landscapes, the students' ability to apply these techniques to certain problems in landscape management as well as the students' ability to precisely describe solutions to achieve certain results within a limited amount of time.
A Mid-Term assignment (presentation) assesses the students' ability to communicate management plans based on vegetation and habitat data. It will serve for grade improvement by 0,3 according to §6 (5) APSO.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in GIS, remote sensing, for example learned by attending the module "Inventory Methods, Statistics and GIS".
Basic knowledge of population biology, community and ecosystem ecology.

Inhalt:
GIS:
1. Advanced analysis and visualization of spatial data
2. GIS based raster analysis
3. GIS and satellite navigation
4. Application of GIS in selected projects
5. Introduction to the vegetation ecology, theory of plant distribution and of plant communities
6. Methods of habitat mapping
7. Habitat mapping in the field
8. Field data analysis
9. Management measures for management plans

Vegetation Ecology:
1. Vegetation ecology: overview, historical notes and outline;
2. Vegetation and the environment: classification of natural & semi-natural vegetation;
3. Clonality in plant communities & seed ecology and assembly rules in plant communities;
4. Species interactions structuring plant communities;
5. Vegetation and the ecosystem & vegetation dynamics;
6. Plant functional types and traits & diversity and ecosystem function;
7. Vegetation conservation, management and restoration;
8. Plant invasions and invasibility of plant communities;
9. Vegetation mapping: vegetation types and scales, from landscape to regional;
10. Practical aspects of vegetation sampling and classification.

Lernergebnisse:
At the end of the module students are able to:
• Manage, analyze and visualize spatial data to solve problems related to landscape management
• Break down general problems in landscape management to tasks which can be solved by using a GIS
• Develop and communicate management plans based on vegetation and habitat data
• Ascertain and classify habitats
• Understand the basic principles for the study of plant communities
• Identify vegetation types and describe its main aspects
• Apply different methods of vegetation sampling and classification

Lehr- und Lernmethoden:
Theoretical explanation of certain topics followed by practical exercises using GIS software supported by screen animations.
Transfer of theoretical knowledge in lectures (vegetation ecology, habitat mapping), practical fieldwork and presentation of proposals for landscape management measures.

Introduction of theoretical and methodological aspects related to vegetation ecology studies, classification of vegetation types and practical aspects regarding the discipline.

Medienform:
GIS Software, PowerPoint Presentations, Instruction videos.

Literatur:
Vegetation Ecology, 2nd edition (Edited by Eddy van der Maarel & Janet Franklin)
Vegetation Ecology of Central Europe, vol. I and II (by Christoph Leuschner & Heinz Ellenberg)
Global Vegetation – Fundamentals, Ecology and Distribution (by Jörg S. Pfadenhauer & Frank A. Klötzli)
The Ecology of Plants (by Jessica Gurevitch)
Vegetation Description and Data Analysis – A Practical Approach, 2nd edition (by Martin Kent)
From Plant Traits to Vegetation Structure – Chance and selection in the assembly of ecological communities (by Bill Shipley)
Data Analysis in Vegetation Ecology, 3rd edition (by Otto Wildi)

Modulverantwortliche(r):
Döllerer, Martin; Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
GIS (Landscape Management) (Vorlesung mit integrierten Übungen, 2 SWS)
Döllerer M

Vegetation Ecology (Vorlesung, 2 SWS)
Teixeira Pinto L
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2719: Landscape Planning | Landscape Planning

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The attainment of learning outcomes for the module will be assessed in a piece of research paper of around 10 pages in which students work independently on complex issues of contemporary landscape planning demonstrating their breadth of understanding in drawing out implications of their findings and putting them into a broader context. The written assignment is complemented by a presentation and/or a colloquium of around 30 min for assessing the capacity of the students to communicate their findings orally to an audience. Depending on the number of participants, research paper and accompanying talk may be prepared either individually or in groups.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic understanding of environmental systems; Module WZ2713 Methods of Scientific Communication. For the LP seminar, class discussion is a core element. Therefore, students are expected to take part and contribute to the discourse.

Inhalt:
Concerned with the stewardship and enhancement of environmental systems, Landscape Planning is the key planning instrument for nature conservation and landscape management in Germany. The module introduces Landscape Planning and reflects on its potential contribution to sustainable land use with a focus on non-urban areas.
Course 1: Lectures will address the guiding principles, formal instruments and procedural elements of Landscape Planning; present methodological approaches for the assessment of landscape functions and ecosystem services including methods and tools for data collection, analysis and evaluation; illustrate target formulation and implementation strategies with examples from the planning practice.

Course 2: The seminar gives students the opportunity to deepen their knowledge by reflecting on readings and planning documents as well as by discussing in class such topics as: contemporary and emerging scientific theories and methodological approaches relevant for environmental planning; rationale of stakeholder involvement; context-dependency of spatial planning; comparison of current jurisdictional and institutional arrangements on landscape-related planning in the home countries of the students and their implications.

Lernergebnisse:
Upon completion of the module, students are able to:
- recognize the purpose and objectives of Landscape Planning;
- explain instruments and procedural elements of contemporary Landscape Planning;
- select appropriate methods and tools to assess landscape functions and ecosystem services;
- be aware of the role of Landscape Planning in the decision-making upon the use of land;
- retrieve and interpret information from different sources;
- communicate key concepts relevant for environmental planning (both written and oral).

Lehr- und Lernmethoden:
Lectures provide subject specific knowledge; class discussions of selected readings engage students in critical thinking; in group work activities students experience the application of selected methods and tools.

Medienform:
Lectures, presentations, class discussions, small group exercises, assigned readings.

Literatur:
Haaren, C. v., Lovett, A. & C. Albert (2019): Landscape Planning with Ecosystem Services – Theories and Methods for Application in Europe. Springer Nature, Dordrecht. Additional material will be provided.

Modulverantwortliche(r):
Dr. Isabel Augenstein i.augenstein@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Landscape Planning - lecture (Vorlesung, 2 SWS)
Augenstein I

Landscape Planning - seminar (Seminar, 2 SWS)
Augenstein I
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4094: Landscape Management - Application Study | Landscape Management - Application Study

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 95	**Präsenzstunden:** 75

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The assessment is based on: 1. the participation intensity on discussions and the quality of the contributions during the courses; 2. the demonstrated skills in creating new data layers by combining existing data from official sources (administrations, organizations, etc.) using GIS techniques, in exploring new data and information layers (RS, vegetation ecology), etc. 3. the contribution in developing the project (planning competences); 4. the presentation style, contents and layout; 5. the team work; 6. the project report.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
The successful completion of the modules "Inventory Methods and GIS", "Remote Sensing and Image Processing", "Geographical Information Systems and Vegetation Ecology" and "Landscape Planning" or equivalent skills are required, courses on scientific writing and reporting recommended.

Inhalt:
1. Implementation of GIS and RS techniques.
2. Implementation of theoretical concepts of Vegetation Ecology;
3. Implementation of theoretical concepts of Landscape Planning;
4. Oral presentation of findings;
5. Elaboration of a final report.

Lernergebnisse:
At the end of the module the students are able to develop or at least to contribute to a landscape management project. More in detail the students are able to:

- work in a team;
- apply the theoretical and practical skills in vegetation ecology, landscape planning, remote sensing and GIS techniques;
- contribute to context-dependant landscape-related planning;
- deliver an oral presentation to communicate their findings;
- prepare a convincing project report using supporting data to back their statements in accordance with guidelines for scientific writing.

Lehr- und Lernmethoden:
Prime characteristic of the Application Study is the self-organized group work by the students to reach the defined objective of the project assignment. Progress of the team is supported by group discussions, theory input and coaching provided by lecturers on demand.

Medienform:
Scripts and reports of the above listed lectures and exercises offered within the elective field; basic data sets to develop the application study (GIS, RS, etc.); additional information on request and up on necessity (project driven).

Literatur:
The literature recommended within the Modules "Inventory Methods and GIS", "Remote Sensing and Image Processing", "Geographical Information Systems and Vegetation Ecology", "Landscape Planning and Applied Development Cooperation" should be used.

Modulverantwortliche(r):
Dr. Thomas Schneider – Professur für Waldinventur und nachhaltige Nutzung Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, 08161/ 71-4666; tomi.schneider@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Landscape Management - Application Study (Vorlesung mit integrierten Übungen, 5 SWS)
Augenstein I, Döllerer M, Schneider T, Teixeira Pinto L
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2737: Remote Sensing and Image Processing | Remote Sensing and Image Processing

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 80	**Präsenzstunden:** 70

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Achievements will be assessed by exercises, a presentation and a final report. On behalf of home exercises the students get a first insight into concepts of image analysis. “Hands on” exercises with state of the art software packages are employed to train the main image processing steps and to assess the understanding of the students in implementing the basic concepts of remote sensing from data take to data analysis. Regular discussions with the tutor measure the student’s ability to develop an idea from initial concepts to the complete picture within a given timeframe, delivering interim results at relevant milestones (35%). On behalf of a presentation of a topic related to remote sensing the student’s ability to understand a technical/scientific subject, to analyze and evaluate facts and factors of influence, to summarize the subject and present it to an audience, and to conduct a discussion about the presented subject is assessed. With the final report the students demonstrate that they have gained deeper knowledge of the specific image analysis software packages and its components, of differing analysis concepts and that they are prepared to evaluate an existing situation as imaged by the respective remote sensing data set. They demonstrate further that they are able to create new geodata layers appropriated to be analyzed in an integrating GIS environment (65%).The grade weights of module examination components correspond to the weighting factors given in brackets.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Module "Inventory Methods and GIS" of the 1th semester of the Master Program "Sustainable Resource Management" passed, computer skills at least at working level .

Inhalt:
The implementation of data interpretation and information extraction concepts and techniques is trained "hands on" with the help of advanced image processing and analysis programs. Topics: 1. Introduction to image processing concepts; 2. Implications of air- and space borne data takes; 3. Data types: Digital aerial photographs, high to very high resolution multispectral and hyperspectral scanner data, LIDAR data; 4. Development of interpretation keys; 5. Exercises on data pre-processing; 6. Unsupervised and supervised classification concepts, pixel-based, object based classification strategies; 7. Exercises on land use/land cover classification; 8. Basic verification concepts; 9. Exercises on the extraction of bio-geo-chemo-physical parameter from RS data; 10. Change detection concepts; 11. Interrelation of Remote Sensing with GIS; 12. Access and data download from geodata provider.

Lernergebnisse:
At the end of the Remote Sensing and Image Processing module (RSIP) the students are able to:
- decide which data set is most appropriated to solve his thematic task, - access data bases, download and open a data set for image processing, - geocode/georeference digital data sets,
- develop appropriated interpretation keys fitting the data set and the targeted thematic goal,- visualize and enhance the data set for interpretation, - extract spectral signatures, - calculate indices on behalf of the data,
- learn how to extract bio-geo-chemo-physical parameter from the data set, - perform unsupervised and supervised classifications, - proof the quality of the results by an accuracy assessment, - perform a change detection study, - export the results as GIS layer.

Lehr- und Lernmethoden:
By using advanced image processing software packages the theoretical explained concepts are exercised “hands on” and discussed on basis of different data types applying the “just in time teaching (JiTT)” technique; the practical courses are prepared by homework (presentation of specific related topics, exercises); the short presentations will be given during the courses, contents, layout and style discussed and narrated; the home exercises explained in close relation to the computer exercises just done. The definition of the problem to be solved by image analysis techniques and the development of appropriated solutions needs research of reference materials. The final outcome of the courses, the classification result, will be used as basis for the Module “Application Study” of the concentration field “Landscape Management”.

Medienform:
Image processing software and tutorials, prepared exercises, different data types

Literatur:
The literature recommended within the Modules "Inventory Methods and GIS", "Remote Sensing and Image Processing", www.wiau.man.ac.uk/courses/cvmsc/Terminol.htm#SplitMerge;http://www.pfc.cfs.nrcan.gc.ca/landscape/inventory/wulder/large_area_rs/index.html; http://www.pfc.cfs.nrcan.gc.ca/landscape/inventory/wulder/hirespres.html; Uni Zürich, RSL: http://www.geo.unizh.ch/rsl2/; EARSeL: http://www-earsel.cma.fr/; http://www.ccrs.nrcan.gc.ca/ccrs/

eduref/tutorial/indexe.html; http://observe.ivv.nasa.gov/nasa/education/reference/main.html; http://rst.gsfc.nasa.gov/starthere.html

Modulverantwortliche(r):
Dr. Thomas Schneider – Fachgebiet für Waldinventur und nachhaltige Nutzung
tomi.schneider@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Remote Sensing and Image Processing (Vorlesung, 6 SWS)
Mengesha M, Schneider T
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Renewable Resources | Renewable Resources

Modulbeschreibung

WZ2720: Renewable Energy Technologies | Renewable Energy Technologies

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The examination consists of a written test, where the students have to proof that they understand and remember the basic technical principles related to energy production and the working principles of the presented renewable energy technologies, as well as the related ecological and economical properties and frame conditions. The students have to answer questions, but may also be asked to do calculations, complete figures or prepare sketches.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
General understanding of natural science, mathematics and basics of technology.

Inhalt:
The course provides an overview of the basics of thermodynamics and the principles of energy conversion. Energy conversion and its importance for the economy is discussed. Because of their transitional character due to the German “Energiewende”, the course focusses on the European and German energy systems. The international students in the course are expected to support the lecture with their experiences from abroad.
Basic technical principles of energy production, efficiencies, costs and environmental impacts will be understood. The focus lies on the following areas: solar, wind, water and geothermal energy conversion.
In order to complete the picture, also storage and fossil fuel technologies will be discussed. The students will understand their role and their contribution to balancing energy production and demand.

Lernergebnisse:
At the end of the course, the students understand the technical principles of renewable energy conversion systems.
They are able to interpret energy scenarios and solve simple problems associated with a high renewable energy share and its implications on society.
The students can estimate the importance of distinct technologies for a sustainable energy supply.

Lehr- und Lernmethoden:
The course provides an overview of the basics of thermodynamics and the principles of energy conversion. Energy conversion and its importance for the economy is discussed. Because of their transitional character due to the German “Energiewende”, the course focusses on the European and German energy systems. The international students in the course are expected to support the lecture with their experiences from abroad.
Basic technical principles of energy production, efficiencies, costs and environmental impacts will be understood. The focus lies on the following areas: solar, wind, water and geothermal energy conversion.
Lecture with integrated exercises and teamwork, as well as discussions to improve understanding.

Medienform:
Power point presentation, black board, Videoclips

Literatur:
Tba

Modulverantwortliche(r):
Dr. Doris Schieder - Lehrstuhl für Chemie Biogener Rohstoffe doris.schieder@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Renewable Energy Technologies (Vorlesung, 4 SWS)
Wieland C [L], Wieland C
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2721: Agriculture Raw Materials and their Utilization | Agriculture Raw Materials and their Utilization [ARM&U]

Modulbeschreibungsversion: Gültig ab Wintersemester 2020/21

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The module grade is assessed by a written exam (60 min). The students show that they have understood the principles of biomass production for bioenergy use, biomass supply chains, and the different bioenergy systems. The written exam demonstrates the student’s ability to deal with questions, and calculations, complete figures or prepare sketches in regard to biomass production for bioenergy use.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
General understanding of natural science, mathematics and basics of technology.

Inhalt:
The targets for the module “Agriculture Raw Materials and their Utilization” are impart a basic understanding of the possibilities and limitations for the agricultural production of biomass for energetic and industrial uses and to provide an overview of ecological impacts of diverse biomass and bioenergy utilization pathways.
The module comprises a lecture which deals with the following topics:
- Production of agricultural biomass and the most important energy and industry crops
- Biomass chains and uses
- Diverse bioenergy systems
- Bioeconomy & biorefineries (related to Agricultural products)
Ecological impact assessment of biomass and bioenergy utilization.

Lernergebnisse:
At the end of the module students have acquired knowledge of the production and utilization of renewable resources from the agricultural and forestry sector.
They know how to analyze the performance and ecological impacts of different biomass supply and utilization chains. They can estimate the suitability of various crops for bioenergy use. The students have an insight in the physical and chemical basics of energy production from biomass and are able to apply related basic equations. They can compare different biomass combustion systems and attribute emissions. The students know the production pathways and properties of different biofuels for transportation and are able to estimate their future potentials. They understand the technological background of biogas production and can do basic designs of biomass supply and utilization chains using the example of biogas systems in agriculture.

Lehr- und Lernmethoden:
The lecture with integrated exercises and discussions will improve the understanding. During the lecture a power point presentation related to the lecture topics will be done from each student to improve the discussion in the different topics of the module.

Medienform:
Power point presentations, black board. Videos, Online Quiz.

Literatur:
Hijazi, O; Munro, S; Zerhusen, B; Effenberger, M. (2016): Review of life cycle assessment for biogas production in Europe. Renewable and Sustainable Energy Reviews (54), 1291-1300.

Modulverantwortliche(r):
Hijazi, Omar; Dr. rer. agr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4098: Forestry Raw Materials and their Utilization | Forestry Raw Materials and their Utilization

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning success will be assessed by a written examination (duration 60 min) where students are expected to demonstrate the level of knowledge and their ability to use and apply it in solution finding strategies. Additionally a midterm Assignment, the students have to prepare and give a structured oral presentation in a seminar organized at the end of the summer term. The topic of the presentation is defined in agreement with the lecturer. The presentation may be prepared either individually or in groups of two. The midterm presentation Assignment allows to improve the examination mark by 0.3.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basics of biology, chemistry, physics and sciences to deal with the biological production, and the processing and conversion processes of wood to final products, and the environmental assessment.

Inhalt:
1. Overview and global potential of forest resources;
2. Availability, characteristics and properties of forest based products (wood and non-timber forest products);
3. Technologies and processes from raw materials to final products: sawn timber, wood-based products, pulp and paper;
4. Criteria and rules of a resource efficient application;
5. Environmental assessment of forestry raw materials and products.

Lernergebnisse:
Upon successful completion of the module students are able to:
- illustrate the multidisciplinary of forests and their products;
- propose options to maximize the value chains of forest based products;
- exemplify production and process technologies and typical sector industries;
- demonstrate the role, potential and limitations of forestry raw materials in the framework of sustainable development;
- outline economical, environmental and social aspects of typical products and applications;
- develop strategies to strengthen the value and impact of typical forestry raw materials and non-timber forest products.

Lehr- und Lernmethoden:
Lecture, exercises, seminar, Optional: visits to laboratories and industry.

Medienform:
Demonstration material: raw materials and products; PP presentations; videos.

Literatur:
Fengel, D.; Wegener, G. (2003): Wood - Chemistry, Ultrastructure, Reactions. Kessel Publishers
Dinwoodie, J.M. (2000): Timber: Its nature and behaviour. Van Nostrand Reinhold Publishers
Forest Products Laboratory (ed) (2010): Wood as an Engineering Material: http://www.fpl.fs.fed.us-documnts-FPLGTR-fplgtr.113-PL113.htm.
Rowell R. ed. (2012): Handbook of Wood Chemistry and Wood Composites. Sec. Edition, CRC Press Taylor & Francis Group, 703 pp.
Shmulsky, R., Jones P.D (2011): Forest Products & Wood Science, 6th ed. Wiley-Blackwell, Chichester UK

Modulverantwortliche(r):
Prof. Dr. Klaus Richter – Lehrstuhl für Holzwissenschaft Winzererstr. 45, 80797 München, Tel.: 089/ 2180 - 6421, richter@hfm.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Forestry Raw Materials and their Utilization (Vorlesung, 2 SWS)
Richter K, van de Kuilen J, Sanchez-Ferrer A

Forestry Raw Materials and their Utilization (Übung, 2 SWS)
Richter K, van de Kuilen J, Sanchez-Ferrer A
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4202: Political and Social Perspectives of Renewable Resources | Political and Social Perspectives of Renewable Resources

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 105	**Präsenzstunden:** 45

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Oral presentation of the group project work, review paper for a scientific journal. The learning outcomes are assessed by a group project work concerning a selected topic related to the political and social perspectives of renewable resources. Therefore students have to prepare a scientific paper for an international journal of their choice and give a short oral presentation about the work done for the paper, similar to what would be expected in a 15 minute conference presentation.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Knowledge of sustainable resources (materials and energy). Scientific writing.

Inhalt:
In the lectures a number of examples of societal aspects of Sustainable Resource programs will be presented and discussed. Backgrounds are global developments such as urbanization, the rise of countries like China and India, resource availability and technological developments. Case studies deal with tropical forestry and pros and cons of tropical hardwood uses, urban planning, vernacular architecture and the use of renewable resources We take a tour around the world and look at social housing programs in Europe, Brazil and South-East Asia. Furthermore we look at successes and failures in the German/European energy policies in comparison to the United States.

Lernergebnisse:
After this course, students should be able to:

1. Develop SR stimulation programs on country or regional level and priority analysis of renewable resource applications
2. Assess priorities for development and application of renewable resources in countries with different levels of development
3. Critically analyze existing SR programs taking into account social values of stakeholders,
4. Assess impacts of global developments such as urbanization and UN-policies on SR.

Lehr- und Lernmethoden:
Discussion and creativity sessions. Project work evolving in a scientific paper for a journal of choice. Oral presentation.

Medienform:
Lectures, UN-policy notes, Discussion and Creativity sessions.

Literatur:
Tba

Modulverantwortliche(r):
van de Kuilen, Jan Willem; Prof. Dr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Political and Social Perspectives of Renewable Resources (Vorlesung, 4 SWS)
van de Kuilen J [L], van de Kuilen J, Westermayr M
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Material and Waste Management | Material and Waste Management

Modulbeschreibung

WZ4206: Material Flow Management and Applications | Material Flow Management and Applications

Modulbeschreibungsversion: Gültig ab Wintersemester 2018/19

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 105	**Präsenzstunden:** 45

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The examination consists of a research paper of around 12-15 pages which is the means to evaluate whether the students have understood and whether they are able to apply the methodology of material flow management on a case study in a scientifically manner and to create an own scientific paper about concepts for material flow management and treatment of materials based on the methodologies of material flow analysis and life cycle assessment.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
knowledge in natural science (biology, chemistry, ecology, physics);
understanding for engineering science and also for social/cultural aspects.

Inhalt:
The students acquire detailed and differentiated knowledge about the following topics:
- need of material flow management
- procedure of material flow management
- material and substance flow analysis
- material flow assessment by sustainability indicators
- life cycle assessment
- development of strategies and measures for material flow management
(e.g. resource efficiency, urban mining, industrial ecology, bio-economy, circular economy).

Lernergebnisse:
By the means of the module the students are able to:
- understand the necessity of material flow management
- understand the relationships between different processes, technological treatments of materials and organizational measures
- apply the procedure of material and substance flow analysis
- apply the assessment methods of indicator systems and life cycle assessment
- create concepts for material flow management and treatment of materials.

Lehr- und Lernmethoden:
Concerning teaching methods, lecture and presentation parts provide the theoretical foundation of materials flow management. Real case studies are introduced to the students and worked out in the class. Likewise within interdisciplinary projects in reality, the students have to define and to solve problems collaboratively in group work by studying specialist literature and data sources. At the end they have to create a research paper as homework about this topic. The students are supervised by tutorials by the lecturer.

Medienform:
Power point presentation, lecture sheets, case studies of material and substance flow analysis and life cycle assessment.

Literatur:
Brunner, P.H., Rechberger H. (2004): Practical Handbook in Material Flow Analysis. Advanced Methods in Resource and Waste Management. Lewis Publishers, Boca Raton, pp. 318.
Brunner, P.H.; Rechberger, H.; 2016: Handbook of Material Flow Analysis: For Environmental, Resource, and Waste Engineers. Taylor & Francis Inc; 2. Revised Edition, pp. 453
Weber-Blaschke, G.; 2009: Stoffstrommanagement als Instrument nachhaltiger Bewirtschaftung natürlicher und technischer Systeme. Ein kritischer Vergleich ausgewählter Beispiele. Schriftenreihe „Nachwachsende Rohstoffe in Forschung und Praxis“ des Wissenschaftszentrums Straubing, Bd. 1, Verlag Attenkofer, Straubing, 330 S.

Modulverantwortliche(r):
Prof. Dr. Gabriele Weber-Blaschke - Lehrstuhl für Holzwissenschaft Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising; 08161/71- 5635; weber-blaschke@hfm.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Material Flow Management and Application (Vorlesung, 3 SWS)
Weber-Blaschke G [L], Weber-Blaschke G
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4207: Waste and Waste Water Treatment | Waste and Waste Water Treatment

Modulbeschreibungsversion: Gültig ab Wintersemester 2020/21

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The written exam (90 min.) consists of general questions and simple calculations. In the written exam students demonstrate their theoretical knowledge of waste and wastewater treatment. The answers require wording but also single choice tests as well as calculations. Only the use of a calculator is allowed (closed book exam).

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Interest and basic knowledge in chemistry, physics, biology and preferably in environmental, chemical, civil or process engineering. However, the level of the course is adapted to the known broad spectrum of background knowledge allowing also students to follow you hold a bachelor in a totally different realm.

Inhalt:
Waste management:

1. Basics of waste management (What is waste, waste amounts, history and future of waste, waste legislation);
2. Avoidance and recovery of waste and waste management concepts;
3. Waste disposal (legal aspects of landfill, processes in above-ground landfill, above-ground landfill technologies, underground disposal sites);
4. Biological treatment (legal aspects, composting, fermentation, mechanical biological treatment, sewage sludge,
substitute fuels);

5. Thermal treatment (legal aspect, thermal processes, equipment, power generation, alternative thermal processes, hazardous waste treatment).

Wastewater treatment:

1.Water treatment & management concepts; overview wastewater treatment steps
2. Wastewater characteristics & discharge limits
3. Mechanical wastewater treatment
4. Fundamentals in bioprocess technology; stoichiometry of biological reactions; kinetics of biological reactions; aeration
5. Biological wastewater treatment
6. Sewage sludge treatment
7. Field trip Garching wastewater treatment plant (optional)

Lernergebnisse:
At the end of the module, students are able to:

1. Understand the necessity and objectives of waste management.
2. Understand the most important processes and technologies for waste treatment.
3. Decide which treatment method is valid for which type of waste.
4. Understand sources and types of emissions arising from waste treatment and measures for emission reduction

8. Understand the necessity and the feasibility of wastewater treatment especially in treating municipal wastewater.
9. Classify the single steps of eliminating wastewater compounds, such as coarse material, organic and inorganic pollutants.
10. Recall important treatment processes and their requirements.
11. Asses pros and cons of different treatment technologies.

Lehr- und Lernmethoden:
The knowledge in the field of waste management is imparted during lectures. Theoretical background is given and discussed at practical examples of existing waste management infrastructure (Collection Systems, Landfills, Treatment Facilities, etc.)

The content of the lecture are taught through practical examples. By means of example tasks in the lecture, possible solutions are discussed and exemplified calculations are performed. An optional field trip to the Garching wastewater treatment plant at the end of the course allows connecting theoretical knowledge with practical application and gives a final platform for questions.

Medienform:
The course is mainly taught by PowerPoint presentation and supported by notices on the black board. The lecture notes are uploaded to Moodle. It is ensured that further readings are available in the university library either for download or as hardcopy in an adequate number.

Literatur:
Waste Management:
Bilitewski, B., Härdtle, G., Marek, K.; Weissbach, A.; Boedekker, A.: Waste Management, Springer-Verlag Berlin Heidelberg, ISBN-10: 9783642082122

Waste Management: https://issuu.com/tkverlag/docs/waste_management_4
Evans, G. (Ed): Biowaste and Biological Waste Treatment, ISBN: 978-1-902916-08-8

Wastewater Treatment:
la Cour Jansen, J., Arvin, E., Henze, M., Harremoes, P., 2019. Wastewater treatment - Biological and chemical Processes. Polyteknisk Boghandel og Forlag, Lyngby.
Tchobanoglous, G., Burton, F.L., Tsuchihashi, R., Stensel, H.D., 2013. Wastewater Engineering: Treatment and Resource Recovery. McGraw-Hill, Boston.
Wiechmann, B., Dienemann, C., Kabbe, C., Brandt, S., Vogel, I., Roskosch, A., 2013. Sewage sludge management in Germany. Umweltbundesamt, Bonn.

Modulverantwortliche(r):
Konrad Koch

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Waste Management (Vorlesung, 2 SWS)
Franke M

Waste Water Treatment (Vorlesung, 2 SWS)
Koch K
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2723: Utilization and Treatment of Special Materials and Waste | Utilization and Treatment of Special Materials and Waste

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 30

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning outcome will be assessed by presentation. The presentation will be complemented by a brief written precis. This assessment method is a good means to evaluate both whether the students are able to work self-reliantly on a topic and to present their significant results to an auditorium and whether they have understood their respective selected topic.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in natural science (biology, chemistry, ecology, physics) and engineering.

Inhalt:
The students acquire detailed and differentiated knowledge about the following topics:

- Selected materials, products and production processes concerning high waste generation and heavy environmental problems
- Origin and types of the specific wastes,
- Classical disposal,
- Waste as a source of raw material,
- Utilization for products,
- Energetic utilization,
- Legal specification.

The special topics addressed depend on relevance, e.g. food and food waste, sewage sludge, e-waste or the like.

Lernergebnisse:
By the means of the module the students are able:

- to describe the differences of special waste, e.g. food waste and selected municipal or industrial waste,
- to classify the amount and quality of special waste streams,
- to analyze problems concerning the special wastes,
- to develop treatment measures to handle the waste for avoiding or reducing impacts on the environment and human health,
- to transmit developed solutions to other waste and new products.

Lehr- und Lernmethoden:
The module consists of a lecture, providing the theoretical foundations, in combination with a seminar including feedback by the lecturers to the students' work. The students have to define and to solve problems collaboratively in group work by studying specialist literature. At the end they have to prepare a presentation and a brief summary including problem statement and conclusions as homework under time constraint about this topic. The students are supervised by the lecturers.

Medienform:
PowerPoint Presentation

Literatur:
Oreopoulou V.; Russ W. (2007): Utilization of By-Products and Treatment of Waste in the Food Industry, Springer; New York.
Additional literature depending on themes.

Modulverantwortliche(r):
Prof. Dr. Gabriele Weber-Blaschke - Lehrstuhl für Holzwissenschaft Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising; 08161/71- 5635; weber-blaschke@hfm.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Utilization and Treatment of Special Materials and Waste (Seminar, 2 SWS)
Weber-Blaschke G [L], Reh K
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2724: Emission Control in Land-Use and Animal Husbandry | Emission Control in Land-Use and Animal Husbandry

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 105	**Präsenzstunden:** 45

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The oral examination will be held either as an individual or a group examination. If more than 40 students sign in for the examination the oral examination can be done in a written form. The duration of the oral examination is 20 min per person. The Students are able to describe typical agricultural production, the environmental impact and the measurement procedures to quantify and to qualify these impacts. On that basis they are able to weigh the advantages and disadvantages of possible measures of air pollution in agriculture.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Interest in the field of agriculture; willingness to learn about the causal relation between agriculture and emission control.

Inhalt:
Upon completion of the module, students are able to understand and analyze:
• the principle of agriculture in plant and livestock production on a basic level
• the main emissions caused by agricultural processes on a deeper level
• interactions of agricultural processes with the emission
• the environmental effects of these emission
• the measurement procedures to qualify and quantify agricultural emissions
• possibilities of emission abatement in land-use and animal husbandry.

Lernergebnisse:
At the end of the module students are able to:
- understand the interrelation between local causes and global impacts,

- apply the comprehension of basic physical, chemical, and biological principles to phenomena in practice,
- evaluate measurement techniques in a qualitative manner,
- evaluate measures and techniques of environment protection;
- understand the interrelation between animal husbandry and air pollution control,
- derive adequate measures of environmental protection.

Lehr- und Lernmethoden:
Lecture, practice course.

Medienform:
PowerPoint-slides, short clips.

Literatur:
Tba

Modulverantwortliche(r):
Dr. Stefan Neser – Bavarian State Research Center for Agriculture; Institute for Agricultural Engeneering and Animal Husbandry; Voettinger Strasse 36, 85354 Freising, 0049 8161 713566; stefan.neser@lfl.bayern.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Emission control in Land-Use and Animal Husbandry (Vorlesung, 3 SWS)
Lichti F, Neser S
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Agricultural Land-Use Systems | Agricultural Land-Use Systems

Modulbeschreibung

WZ2725: Land-Use Systems from Local and Global Perspectives | Land-Use Systems from Local and Global Perspectives

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning outcome will be assessed by an oral exam (duration: 30 minutes).
In this form of exam the students can show how they are able to explain the farming systems and describe the elements and farming methods. Due to a deeper discussion the examiner is able to evaluate the students under-standing of farm practices, system concepts and interactions with site conditions.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
Basic information on farming: crops, crop rotations, permanent crops: hops and orchards; soil management, weed management; implements and machinery; organic and mineral fertilizers; pesticide use; livestock: animal husbandry, breeding criteria; consumer expectations; exemplified by Bavarian and German cases.
Introduction to farming systems worldwide: pastoral systems, permanent crops plantation systems, mixed systems, arable systems, intensive animal keeping; horticultural systems; students experience with agricultural land use in their countries.

Lernergebnisse:
On successful completion of the module students are able to remember and identify different crops, farm animals, machines and implements. They will be able to describe farming systems

esp. the difference of organic and conventional systems. They will understand farm management methods and interactions inside farming systems. The students can classify land-use systems worldwide and are able to explain the main elements and to evaluate the sustainability and resource impact.

Lehr- und Lernmethoden:
Lectures providing theoretical foundations. Examples will be given during the lectures.
Short field trips to farms and university research station, demonstrating crops, animals, technical equipment.
Short discussion sessions.

Medienform:
Power Point.

Literatur:
Tba

Modulverantwortliche(r):
Dr. Hans-Jürgen Reents; Dipl. Ing. Max Kainz - Lehrstuhl für Ökologischen Landbau und Pflanzenbausysteme Liesel Beckmann Str. 2, 85354 Freising, 08161/71 - 3778, reents@wzw.tum.de, kainz@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2726: Assessment of Sustainability in Agriculture - Theory and Case Studies | Assessment of Sustainability in Agriculture - Theory and Case Studies

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The Assignment (Report+Assessment) is done as groupwork (2-3 students). As the report and assessment is based on a farm visit and to register presented details and understand the complexity of the system group working is necessary. The assignment shows the ability of the students to describe the farming system, to apply the developed criteria of sustainable agricultural practice, to assess the sustainability of farm as a system and to give recommendations for an improved development.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
Sustainability in farms context, principles of sustainability, criteria, inquiry strategies, indicator and indicator concepts, assessment and benchmarking.
Application to farming systems and farms at different level of intensification; case studies based on excursions: arable farming, organic vs. conventional farming, vegetable production in arable farms, grassland based farming system, dairy farming, suckling beef production.

Lernergebnisse:
On successful completion of the module students are able to understand the idea of sustainability in the context of farms. They will have the ability to create criteria and indicators to assess sustainability of farms and to built up benchmarking systems. The students can describe farming

systems and are able to evaluate the sustainability using criteria and indicators and to document them in a report.

Lehr- und Lernmethoden:
Lectures with presentation of principles and systematics
Reading papers
Group work, mind mapping, meta plan technical to document discussion results.

Medienform:
Power Point, Flip Chart, Pin wall, Metaplan technic

Literatur:
Tba

Modulverantwortliche(r):
Dipl. Ing. Max Kainz; Dr. Hans-Jürgen Reents - Lehrstuhl für Ökologischen Landbau und Pflanzenbausysteme, Liesel Beckmann Str. 2, 85354 Freising, 08161/71 - 3778, kainz@wzw.tum.de, reents@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Assessment of Sustainability in Agriculture- Theory and Case Studies
Hans-Jürgen Reents, Max Kainz
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2727: Sustainability of Food Chains | Sustainability of Food Chains

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Combination of Poster and oral presentation provides to assess the students ability to conduct a life cycle analysis of a special food product. The poster needs a very concentrated presentation, focus on the important information and factors and shows the students capability to understand the principles of the LCA and the special food production process.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Attendance in Module 4209 and 4210 is recommended.

Inhalt:
Food chains of processed food, from agricultural production via processing to packed product unit in a food store, principles of life cycle analysis, assessment criteria, energy input output ratio, energy efficiency, CO2 emission, carbon footprint, virtual water
LCA calculation and calculation program (Umberto).

Lernergebnisse:
At the end of the module the students are able to understand food chains. They can describe and apply life cycle analysis to processed food products. They are able to assess energy and emission impact of different crop and animal production system and processing procedures. The will get basic skills of the software Umberto.

Lehr- und Lernmethoden:
Teachers Presentations Life cycle analysis, food chain, energy, CO2 emission and water impacts, students contributions, special aspects of processing paper reading for contributions to group discussions and outline of the final presentation.

Medienform:
Presentation notes, computer program.

Literatur:
Tba

Modulverantwortliche(r):
Dipl. Ing. Max Kainz - Lehrstuhl für Ökologischen Landbau und Pflanzenbausysteme Liesel Beckmann Str. 2, 85354 Freising, 08161/71 - 3034, kainz@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Sustainabilityof Food Chains
Max Kainz
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2728: Sustainable Land-Use Management | Sustainable Land-Use Management

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
In a Power Point (or comparable tool) supported oral presentation the students can show, how they identify a special issue of farm management related to terms of sustainability. In the further outline of the presentation, the students will show how to discuss the topic based on recorded results from published papers, to explain conclusions and to suggestsolutions on improved sustainability.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
Agricultural systems and their relation to natural and human resources; site, economic and social conditions, regional and global,
adaptation of farm management techniques to principles of sustainability, research and scientific results, terms of politics and social debate, aims and scenarios for future development
Topics selected participative with the students.

Lernergebnisse:
On successful completion of the module students are able to identify special problems of sustainability in farm management, economic and social conditions, to analyze the technical, social and economic impacts and to evaluate them on the background of criteria of sustainability. They will be able to create solutions for critical impacts.

Lehr- und Lernmethoden:
Lectures provide facts, background and theoretical foundations.

Papers have to be read and used in group work.
Group work.

Medienform:
Power Point Presentations
Flip Chart
Pin wall, Metaplan technique

Literatur:
Tba

Modulverantwortliche(r):
Dipl. Ing. Max Kainz; Dr. Hans-Jürgen Reents - Lehrstuhl für Ökologischen Landbau und Pflanzenbausysteme, Liesel Beckmann Str. 2, 85354 Freising, 08161/71 - 3778, kainz@wzw.tum.de, reents@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Case Studies of Land-Use Management
Hans-Jürgen Reents, Max Kainz
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Climate, Air and Water | Climate, Air and Water

Modulbeschreibung

WZ2731: Hydrometeorology and Management of Water Resources | Hydrometeorology and Management of Water Resources

Modulbeschreibungsversion: Gültig ab Sommersemester 2022

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning outcome will be assessed by an oral examination (30 min) in which students should demonstrate their profound understanding of water management and ability to analyze and evaluate key issues and challenges. They should exhibit the capability of identifying and solving problems in a concise way and show that they can express themselves in a clear and scientific manner. A voluntary mid-term assignment (presentation) in the seminar assesses the students' ability to communicate and present an integrated management study case in one selected topic in sustainable water management. It will serve for grade improvement by 0.3 according to §6(5) APSO.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in chemistry and physics.

Inhalt:
1. Hydrometeorology (including hydrological cycles, precipitation-, run off-, evapotranspiration - process of formation, measurement, global and regional spatial and temporal patterns, influences by land use land cover change, climate change scientific basis, climate change impacts, adaptation, vulnerability in water resources).
2. Problems in water management according to too little water, too much or too dirty. Different aspects of water augmentation (e.g. harvesting, desalination, translocation), water conservation (irrigation, pricing, household, …), water management processes (e.g. IWRM, virtual water) are discussed by practical examples;

Lernergebnisse:
Upon the successful completion of this module the students are able to understand the basics of hydrology, and the influence of climate change on hydrological processes and management. They are able to analyze and classify various problems in water resource management and to assess the suitability and applicability of different management practices in the field of water augmentation (e.g. rain water harvesting, fog nets, dams) and water saving strategies (e.g. in irrigation, sanitation) to integratively solve water-resource-problems.

Lehr- und Lernmethoden:
The basics of hydrology and meteorology are presented and discussed in a lecture with thorough explanations. Some simple case studies are used to introduce into the theoretical background (e.g. meteorological instruments at the meteorological platform). Student presentations and discussions, group work in the seminar.

Medienform:
PowerPoint presentations; Presentation notes supporting the lecture. Case studies.

Literatur:
Ahrends (2000) Meteorology today, 7th edition. Jones JAA (2010) Water Sustainability - A Global Perspective, Hodder Education London. Clarke R & King J (2004) The atlas of water. Figueres C. et al. (2003) Rethinking water management. Wescoat JL et al. (2003) Water for life, water management and environmental policy. Grambow M (2008) Wassermanagement.

Modulverantwortliche(r):
Prof. Dr. Annette Menzel - Professur für Ökoklimatologie Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, 08161/ 71-4740, amenzel@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Management of Water Resources (Vorlesung, 2 SWS)
Estrella N, Menzel A

Introduction to Hydrometeorology (Vorlesung, 2 SWS)
Menzel A [L], Estrella N, Menzel A
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2722: Mountain Catchments under Changing Climate | Mountain Catchments under Changing Climate

Modulbeschreibungsversion: Gültig ab Sommersemester 2020

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 80	**Präsenzstunden:** 70

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
In a written exam, students demonstrate that they have gained an understanding of hydrological processes and that they are able to apply and run a hydrological model for a mountain catchment. By an 10min oral presentation and a 5min discussion the students' ability to understand selected hydrology-related threats for mountain catchments and to scientifically analyze and evaluate important influencing factors, to present it to an audience, and to conduct a discussion about the presented subject in a clear and concise scientific manner is assessed. The final grade is an averaged grade from the presentation (65%) and the written exam (35%).

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Introduction in Hydrometeorology and management of water resources.

Inhalt:
In the Field Course Applied Hydrometeorology of Mountain Catchments we will visit selected research stations, field sites, hydrological infrastructure, restoration sites, and protected areas in the Munich PreAlpine and Alpine area and learn more about hydrology-related threats for mountain catchments ranging from Glacier melt to Munich's drinking water. Sites include e.g. Environmental Research Station Schneefernerhaus, KIT Alpine Campus Garmisch, Waldklimastation Kreuth, Sachenbach catchment, Versuchstation Obernach, Sylvensteinspeicher, Walchenseekraftwerk, Versuchsstation Wielenbach, Mangfall / Lech Wassereinzugsgebiet.
The Hydrological Modeling course includes:
1) Dominant hydrological processes in mountain catchments: Precipitation types, runoff generation, concentration and flood routing
2) Data in mountain catchments: Availability, quality, acquisition and analysis

3) Types of hydrological models
4) Generation, parameterization and calibration of the process based hydrological model WaSiM
5) Model sensitivity analyses with focus on meteorological input and land use scenarios.

Lernergebnisse:
After completion of the module, the students understand the main processes in mountain catchments like runoff generation, runoff concentration and flood routing processes. Additionally, they are able to use a physically based hydrological model to simulate the rainfall runoff process in mountain catchments and its influencing parameters caused by the special circumstances of these regions in a widely realistic and transparent way. The students are able to generate event based scenarios as well as land use scenarios and understand recent hydrology-related threats for mountain catchments as well as the influence of climate change on hydrological processes and management in mountain areas. They remember suitable monitoring and risk prevention strategies and are able to analyze, evaluate and communicate (both oral and written) a specific case study or research questions related to the experimental sites visited to a general audience.

Lehr- und Lernmethoden:
Teaching methods include lecture as well as practical exercises at PC laboratory in respect to hydrological modelling, a week of field trip to Alpine and pre-alpine areas to the listed sites with guided tours by local scientists, administrators, TUM lectures as well as short presentations by the students.

Medienform:
PowerPoint Presentation, Hydrological model (e.g. WaSiM), Field work

Literatur:
IPCC (2013) Fifth Assessment Report; Shelton ML (2009): Hydroclimatology - Perspectives and Applications; IPCC (2008) Technical Paper VI on Climate Change and Water

Modulverantwortliche(r):
Responsible for Module: Prof. Dr. Annette Menzel - Professur für Ökoklimatologie Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, 08161/ 71-4740, menzel@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Introduction in Hydrological Modelling (Vorlesung, 2 SWS)
Chiogna G

Field Course in Applied Hydrometeorology (Vorlesung mit integrierten Übungen, 3 SWS)
Menzel A [L], Lüpke M, Menzel A
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2732: Environmental Monitoring and Data Analysis | Environmental Monitoring and Data Analysis

Modulbeschreibungsversion: Gültig ab Wintersemester 2020/21

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 80	**Präsenzstunden:** 70

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Aufgrund des Pandemiegeschehens hat der/die Studierende auch die Möglichkeit, an einer beaufsichtigten elektronischen schriftlichen Fernprüfung (Aufsicht mit Zoom, 180 min.) teilzunehmen (Onlineprüfung: WZ2732o). Diese Prüfung wird zeitgleich parallel in Präsenz angeboten (WZ2732).

Upon completion of the module, the students have a profound understanding of key aspects of environmental monitoringand are able to choose appropriate as well as to efficiently run environmental measurements, to reproducibly analyze acquired data and to clearly communicate results of environmental measurements.
This ability should be demonstrated by writing a research paper following standards of reproducible research based on different aspects of environmental monitoring and data analysis with R. For the research paper, either available data or data measured during the module should be used and be analyzed in respect to defined hypotheses; developed R code has to be provided too.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in R is recommended.

Inhalt:
1 Environmental monitoring including principles, techniques and management issues used in environmental monitoring and assessment; Observing, recording, communicating and archiving collected data and providing it to project stakeholders in order to identify sustainable and responsible environmental practices.
Optional: short course Aerobiology, GAW program, visit of companies

2 Environmental data analysis
Introduction to data analysis with R; Principles of reproducible research and implementation with R; Pipelines for environmental data analysis from obtaining data via cleaning and transforming to modelling and visualization with modern R; Coverage of data retrieval from different storage types for climate, proxy, phenology, and other data (text-based, netCDF, data bases); Modeling and visualization as complementary strategies for hypothesis-driven data analysis, based on published research from different fields of environmental sciences.

Lernergebnisse:
After this module, the students can plan, implement and run environmental measurements. They are able to efficiently analyze environmental data sets, including download and import of data sets and visualization and modelling with R.

Lehr- und Lernmethoden:
Course 1 consists of a practical course in the laboratory and in the field where students will work in small teams on applied case studies and exercises related to environmental / meteorological monitoring. Course 2 then offers combined lecture and exercise sessions at the PC lab on how to efficiently analyze those environmental data sets of course 1.

Medienform:
PowerPoint Presentation, Field work, Interactive documents for data analysis

Literatur:
Beginner level tutorials for Swirl (http://swirlstats.com/)

Modulverantwortliche(r):
Responsible for Module: Prof. Dr. Annette Menzel - Professur für Ökoklimatologie Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, 08161/ 71-4740, menzel@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Environmental monitoring and data analysis; ecological data analysis (Vorlesung mit integrierten Übungen, 3 SWS)
Menzel A [L], Buras A, Krause A, Meyer B

Environmental monitoring and data analysis; ecological monitoring (Vorlesung mit integrierten Übungen, 2 SWS)
Menzel A [L], Lüpke M
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2730: Climate Change - Science, Impacts and Adaptation, Mitigation | Climate Change - Science, Impacts and Adaptation, Mitigation

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Due to Corona, the form of examination has changed as follows.
Assessment consisting of excercises. In a written test (Klausur, duration 60min, 60% of the module grade) the student is expected to demonstrate that he/she has understood the physical basis of the climate system and that they can identify the drivers of climate change.
In three graded exercises the student shows that he/she is able to apply his/her knowledge to develop adaptation and mitigation measures and to argue in discussions on climate change issues. The students prepare a video in groups including a role play of a panel discussion to develop their persuasive and critical skills as organizers and presenters, they become more familiar with political decision-making processes. The video is presented and discussed with all students participating. The grade for the seminar counts 40% of the module it consists of three equally weighted grades for each exercise.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in meteorology, physics, biology.

Inhalt:
Based on the newest IPCC report (AR 5) the theoretical background on the physical science basis of climate change, theory and practical application of adaptation and mitigation measures in biological, physical and chemical systems will be presented. In a related seminar, selected topics will be intensified in case studies. TUM as a NGO in the UNFCCC process offers an optional possibility also for students to take part in COP and related negotiations.

Lernergebnisse:
After this module, the students can understand the physical basis of the climate system, identify all drivers of climate change and falsify common arguing of "climate sceptics". They can summarize observed changes in the climate system as well as impacts in divers systems and regions. They are able to assess cross-sectorial impacts of climate change in selected areas, to evaluate and develop adaptation and mitigation measures and strategies in biological, physical and chemical systems including an analysis of their effectiveness and cost-effectiveness.

Lehr- und Lernmethoden:
Lecture on physical basis of the climate system, impacts of climate change and important mitigation strategies. In the seminar group presentations of various topics regarding adaptation and mitigation of climate change will be presented as case studies. Optional excursion to UNFCCC meeting if applicable.

Medienform:
Lecture with PowerPoint Presentation, reader and exercises. Group work in seminar including problem driven case studies and student presentations, excursion.

Literatur:
IPCC (2013) Fifth Assessment Report of WGI, II, III. Houghton (2015) Global warming, the complete briefing. Most recent scientific literature.

Modulverantwortliche(r):
Rammig, Anja; Prof. Dr. rer. nat.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Ecological, social and economic aspects of CC impacts, adaptation and mitigation on different scales (Seminar, 2 SWS)
Estrella N [L], Menzel A, Estrella N, Ghada W

Climate Change - The complete briefing (Vorlesung, 2 SWS)
Rammig A [L], Rammig A
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Soils and Soil Management

Modulbeschreibung

WZ2733: Introduction to Soil Science | Introduction to Soil Science

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 80	**Präsenzstunden:** 70

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
In a written exam of 60 minutes duration, the students demonstrate by answering questions without helping material their understanding of the nature and properties of soils, and they remember the characteristics of the soils of the field course as well the field assessment methods. In a pass/fail exam (laboratory assignment) in the field of 10 minutes duration, they prove their ability to survey and interpret a soil profile.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in chemistry, physics, and biology.

Inhalt:
• What is a soil?
• Mineral (inorganic) soil components
• Soil biology and soil organic matter
• Soil chemistry
• Soil physics
• Soil-forming processes
• Soil survey
• Soil interpretation
• Soil erosion assessment

Lernergebnisse:
The students understand the basics of soil science. They can use their knowledge from soil mineralogy, soil organic matter, soil chemistry, and soil physics to understand soil formation processes and important biochemical and physical properties. The students are able to survey a soil profile and to detect the genesis of the surveyed soil. They can evaluate the possibilities of soil use, the risks to the soil itself and the risks to its environment. They are able to evaluate the hydrology of the soil and to judge the erosion risk.

Lehr- und Lernmethoden:
The lecture discusses the essentials of soil science. The field assessment starts with peer instructions to analyse a soil profile. During the course, the students will do more and more group work to train the evaluation of a soil profile, its hydrology and its erosion risks.

Medienform:
Lecture: presentation notes. Field Assessment: spade, auger, knife, colour charts, TDR probes, suction cups, erosion assessment kits

Literatur:
Brady, Weil: The nature and properties of soils, 14th edition, 2007.
Blume et al.: Scheffer/SchachtschabelSoilscience, 2016.
Eash, Sauer, O'Dell, Odoi, Bratz: Soil science simplified, 6th edition, 2016.
Blum, Schad, Nortcliff: Essentials of Soil Science, 2016.
FAO Guidelines for Soil Description. Prepared by Jahn, Blume, Asio, Spaargaren, Schad, 2006.

Modulverantwortliche(r):
Schad, Peter; Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Introduction to Soil Science: Lecture (Vorlesung, 2 SWS)
Schweizer S

Introduction to soil science: Field course (Übung, 3,5 SWS)
Wiesmeier M [L], Wiesmeier M, Garcia Franco N, Völkel J, Putzhammer S, Schad P
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2734: Soil Protection | Soil Protection

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
In an oral exam of 30 minutes duration, students demonstrate in a scientific discussion by answering questions without helping material their broad and deep understanding on how to protect soils. The understanding of soils, as achieved in the modules "Introduction to soil science" and "World soil resources", is implicitly part of the oral exam.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
The successful completion of the module "Introduction to Soil Science" or equivalent skills are required. The successful completion of the module "World Soil Resources" is recommended.

Inhalt:
Principles of soil degradation, the world food problem, highly erodible soils, semi-arid environments (including irrigation and salinization problems), kaolinitic soils, shifting cultivation, organic and mineral fertilization, agroforestry, land use and greenhouse gases, soil functions, organic pollutants, inorganic pollutants (heavy metals), radionuclides, pesticides, pathways of pollutants, sorption, precipitation, co-precipitation, acidification, ways to assess the mobility of pollutants, remediation of brownfields.

Lernergebnisse:
The students are able to apply their knowledge of soils, as achieved in the modules “Introduction to Soil Science” and “World Soil Resources”, to develop strategies of soil protection. They understand the major environmental factors that determine the food production in the world. They are able to address the specific problems of highly erodible soils, semi-arid land and kaolinitc soils and to design adequate land-use methods. The students understand the major factors that determine the fate of substances in soil. They are able to analyze and forecast the fate of heavy metals, organic

pollutants and radionuclides in soil and are familiar with important techniques for managing and remediating brownfields.

Lehr- und Lernmethoden:
Lecture, discussions

Medienform:
Presentation notes.

Literatur:
Blanco, H., Lal, R. (2008): Principles of soil conservation and management. Diamond, J. (1998): Guns, germs and steel. A short history of everybody for the last 13,000 years. Mirsal, I. (2008): Soil Pollution.

Modulverantwortliche(r):
Schad, Peter; Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Bodenschutz - Organische und anorganische Schadstoffe in Böden (Vorlesung, 2 SWS)
Bucka F

Soil Protection and World Food Production (Vorlesung, 2 SWS)
Schad P
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2735: World Soil Resources | World Soil Resources

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 80	**Präsenzstunden:** 70

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
In an oral exam of 30 minutes duration, students demonstrate in a scientific discussion by answering questions without helping material their fundamental understanding of the soils of the world in relation to other ecological factors, and they remember the soils of the field course as well as the methods of surveying and classifying soils in the field. In a pass/fail exam (laboratory assignment) in the field of 10 minutes duration, they prove their ability to survey and classify soils of various landscapes and environmental settings. The understanding of soils, as achieved in the module "Introduction to soil science" is implicitly part of the oral exam.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
The successful participation at the module "Introduction to Soil Science" (which is given in the first half of the summer semester) is required.

Inhalt:
• Soils of the world
• Chemical, biological and physical properties of soils
• Genesis of soils as the result of soil-forming processes
• Soil survey
• Soil classification according to the international system
• Soil interpretation.

Lernergebnisse:
The students are able to apply their knowledge of soils, as achieved in the module “Introduction to Soil Science”, to all soils of the world. The students understand the characteristics of the soils of the world, the pattern of their geographical distribution, their genesis, their ecological potential and

the threats to their functions. The students are able to survey a soil profile, to detect the genesis of the surveyed soil and to classify it according to the international soil classification system. They are able to evaluate the possibilities and risks of soil management. They can assess the relationship between the soil and its environmental setting.

Lehr- und Lernmethoden:
The lecture gives an overview of all soils of the world. The field course (several days) presents soils in a landscape outside southern Bavaria. The students are trained in the methodological skills of soil survey, soil classification and soil interpretation.

Medienform:
Lecture: presentation notes. Field Assessment: spade, auger, knife, colour charts.

Literatur:
FAO Guidelines for Soil Description. Prepared by Jahn, Blume, Asio, Spaargaren, Schad, 2006.
IUSS Working Group WRB: World Reference Base for Soil Resources 2014. Update 2015. Prepared by Schad, van Huyssteen, Micheli. FAO World Soil Resources Reports 106.

Modulverantwortliche(r):
Schad, Peter; Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
World Soil Resources: Lecture (Vorlesung, 2 SWS)
Schad P

Bodenansprache und Bodenklassifikation nach internationalen Standards (Übung, 2,8 SWS)
Schad P
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2736: Analytical Characterization of Soil Resources | Analytical Characterization of Soil Resources

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The students hand in a research paper (10-15 pages), in which they present and discuss the analytical data obtained by own laboratory characterization of soil samples that were collected by the students themselves during a guided exercise in the field. The research paper is accompanied by an oral presentation (15-20 min) to assess the scientific communication skills of the students. For the final mark, the research paper accounts for 75% and the oral presentation for 25%.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
The successful completion of the module "Introduction to Soil Science" (WZ2733) or equivalent skills are required.

Inhalt:
• Sampling and sample preparation
• Lab analyses: texture, density, water conductivity, organic and inorganic carbon, nitrogen, soil organic matter
decomposition, pH, cation exchange capacity, Fe oxides, phosphate retention;
• Data interpretation

Lernergebnisse:
The students are able to apply their knowledge of soils, as achieved in the module “Introduction to Soil Science”, to
the most important physical, chemical and biological processes in soils. They are able to choose the adequate

laboratory method to answer a certain question on soil management. They know how to do sampling, sample
preparation and laboratory work. They can interpret laboratory data and know, which conclusions can be made and
which conclusions cannot be made. The students are able to communicate their results in a written and an oral
manner.

Lehr- und Lernmethoden:
For every step, the lecturers give the theoretical background. Afterwards, every step is done by the students
themselves, guided by the lecturers and the laboratory staff: sampling, analyses, data interpretation.

Medienform:
Lecture: presentation notes; sampling: field equipment; laboratory course: laboratory instruments

Literatur:
will be given in the course

Modulverantwortliche(r):
Schweizer, Steffen; Dr. rer. nat.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Analytical characterization of soil resources: Laboratory course (Übung, 3 SWS)
Prietzel J, Schweizer S, Bucka F, Göttlein A, Kolb E, Laniewski R, Leemhuis S

Analytical characterization of soil resources: Lecture (Vorlesung, 1 SWS)
Schweizer S
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Elective Modules | Elective Modules

Modulbeschreibung

BGU38019: Anaerobtechnik und Energierückgewinnung | Anaerobic Processes and Energy Recovery

Modulbeschreibungsversion: Gültig ab Wintersemester 2018/19

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 3	**Gesamtstunden:** 90	**Eigenstudiums-stunden:** 60	**Präsenzstunden:** 30

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Der Leistungsnachweis erfolgt in Form einer 60-minütigen Klausur bestehend aus Fragen zum grundlegenden Verständnis sowie kleineren Rechenaufgaben.
Ziel der schriftlichen Prüfung ist der Nachweis, dass die grundlegende Herangehensweise an typische Aufgabenstellungen im Bereich der Energierückgewinnung aus urbanen Reststoffströmen verstanden wurde und unterschiedliche Verfahrensansätze vergleichend angewendet werden können. Dazu müssen in begrenzter Zeit Problemstellungen analysiert werden und basierend auf den im Rahmen des Moduls erworbenen Kenntnissen, Lösungswege gefunden und umgesetzt werden. Im theoretischen Teil müssen Verständnisfragen zu grundlegenden Zusammenhängen beantwortet werden. Im Rechenteil müssen, basierend auf den im Rahmen des Moduls erworbenen Lernergebnissen, unterschiedlichste Fragestellungen analysiert und berechnet werden.
Die Antworten erfordern teils eigene Formulierungen, teils Ankreuzen von vorgegeben Einfach- oder Mehrfachantworten, wobei der Schwerpunkt auf kurzen Rechenaufgaben liegt. Für die Klausur sind bis auf einen nicht-programmierbaren Taschenrechner keine Hilfsmittel zugelassen.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Water and Wastewater Treatment Engineering (BGU38014)

Inhalt:
• Grundlagen des anaeroben Abbaus
• Co-Vergärung

• Power-to-Gas
• Klärschlammbehandlung
o Landwirtschaftliche und thermische Verwertung
o Phosphorrückgewinnung

Lernergebnisse:
Nach der erfolgreichen Teilnahme an der Lehrveranstaltung sind die Studierenden in der Lage:
• sich an die grundlegenden Verfahrenskonzepte zu erinnern,
• die jeweiligen Vor- und Nachteile der unterschiedlichen Verfahren für die konkrete Anwendung zu analysieren und vergleichend zu bewerten,
• sowie einfache Ansätze zur Berechnung und Dimensionierung derer zu entwickeln.

Lehr- und Lernmethoden:
Die Inhalte der Vorlesung werden anhand praxisnaher Beispiel vermittelt. Mittels Beispielaufgaben in der Vorlesung werden Lösungsansätze diskutiert und beispielhaft Berechnungen durchgeführt. In der in die Vorlesung integrierten Übung wenden die Anwesenden das Gelernte auf ähnliche Aufgaben an und verinnerlichen dabei die Herangehensweise. Das Selbststudium wird durch die Bereitstellung weiterführender Fachliteratur in Moodle unterstützt.

Medienform:
Beamer, Tafel, empfohlene Literatur

Literatur:
Appels, L., Baeyens, J., Degrève, J., Dewil, R., 2008. Principles and potential of the anaerobic digestion of waste-activated sludge. Prog. Energy Combust. Sci. 34, 755–781.
Chen, Y., Cheng, J.J., Creamer, K.S., 2008. Inhibition of anaerobic digestion process: A review. Bioresour. Technol. 99, 4044–4064.
Kelessidis, A., Stasinakis, A.S., 2012. Comparative study of the methods used for treatment and final disposal of sewage sludge in European countries. Waste Manag. 32, 1186–1195.
Roskosch, A., Otto, S., 2014. Technical Guide on the Treatment and Recycling Techniques for Sludge from Municipal Wastewater Treatment with references to Best Available Techniques (BAT). Fed. Environ. Agency Ger.
Wiechmann, B., Dienemann, C., Kabbe, C., Brandt, S., Vogel, I., Roskosch, A., 2013. Sewage sludge management in Germany. Umweltbundesamt, Bonn.

Modulverantwortliche(r):
Dr.-Ing. Konrad Koch, k.koch@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Anaerobtechnik und Energierückgewinnung (Vorlesung, 2 SWS)
Koch K [L], Koch K
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

CS0126: Advanced Seminar in Circular Economy and Sustainability Management | Advanced Seminar in Circular Economy and Sustainability Management [ASCESM]

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 7	**Gesamtstunden:** 210	**Eigenstudiums-stunden:** 150	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
"Term paper and presentation: Students have to write a scientific paper on the given topic (15-20 pages). In doing so they have to show that they are capable to find relevant literature, structure a problem, solve it, and document the results of the process in a scientific paper. In the 30 minute final presentation they have to to show that they are able to summarize their findings in a scientific presentation, discuss and defend them (20' for presentation, 10' for discussion).
Weighting: Term paper 2, Presentation 1"

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
-

Inhalt:
The module deals with actual topics from Circular Economy and Sustainability Management. These differ from semester to semester. Topics will be announced at the end of the preceeding semester.

Lernergebnisse:
The seminar aims at enabling students for scientific work. After passing the module the sutdents are able to find, structure and analyse relevant literature, solve the problem scientifically, discuss the solution critically, summarize the work in a term paper, hold a scientific presentation, and discuss and defend their work. Thereby the students acquire in-depht knowledge on a current topic from the thematic field of circular economy and sustainability management.

Lehr- und Lernmethoden:
Seminar: after an introduction on the topic the students carry out a literature research, structure the problem, identify solution approaches, apply these. They summarize their findings in a term paper and a scientific presentation. In this process they are supervised, receive materials, thematic introductions, advise in scientific work and continuous feedback in the seminar sessions. The seminar closes with a final presentation.

Teaching / learning methods:
- Kick-off session: media-assisted presentation
- Individual work and feedback
- Interim presentations / workshops
- Final presentation
- Computer lab exercises using LCA software systems and Life Cycle Inventory Data bases.

Medienform:
Digital projector, board, flipchart, online contents, recent scientific journal publications, computer lab

Literatur:
Recommended reading:
• Gastel B; Day R A (2017): How to write and publish a sicentific paper, Cambridge University Press
• Glasman-Deal H (2009): Science Research Writing For Non-Native Speakers Of English: A Guide for Non-Native Speakers of English, Imperial College Press
• Skern T (2011): Writing Scientific English: A Workbook, UTB

Topic related reading, especially articles in international peer reviewed journals, will be provided in the kick-off meeting of the module.

Modulverantwortliche(r):
Magnus Fröhling

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Advanced Seminar Circular Economy for a Sustainable Society: From Theory to Practice (Seminar, 4 SWS)
Fröhling M [L], Fröhling M, Heinrich V
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ0246: Advanced Concepts and Methods in Urban Ecosystems | Advanced Concepts and Methods in Urban Ecosystems

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 75	**Präsenzstunden:** 75

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The module assessment is based on participation in group discussions, written critical reflections, and practical work assignments that demonstrate conceptual and applied understanding of course goals.

The examination performance is given in the form of a research paper. The research paper will include a written research proposal (3-5 pages; 80% of grade) complemented by an oral presentation (15 min. + 5 min. discussion; 20% of grade). In the research proposal, each student will develop a research question, hypothesis(es), and experimental protocol to answer their question. Students should situate their research proposal in a theoretical framework, and propose fitting methods to examine their research question. Students will search for and synthesize relevant literature to justify their experimental choices. The final written research proposal will be the culmination of this project and will take the form of a research grant proposal. Students will comply with the same proposal guidelines and rules that graduate (PhD) students must follow when they apply for funding from e.g., Deutsche Bundesstiftung Umwelt (https://www.dbu.de/stipendien_promotion). Written summaries measure each student's understanding and evaluation of environmental/ecological and social concepts, and ability to apply theoretical frameworks and appropriate methods. In the presentation, the students present their research proposal (PowerPoint plus any additional aides) to demonstrate understanding of a research gap in urban ecosystems, communicative competence, presentation and discussion skills in front of an audience.

In addition, there is the possibility to submit a voluntary Mid-Term-Assessment (after APSO §6, Abs.5). For this assessment, students submit exercises, consisting of 3 assignments that were completed through the weekly exercises (e.g. data collection or analysis activity). Students should submit this on Moodle. By pasing this coursework students can improve their module grade up

to 0,3. For the Mid-Term-Assessment, no repetition date is offered. In case of a repetition of the module examination, a previously completed Mid-Term-Assessment will be taken into account.

Wiederholungsmöglichkeit:
Folgesemester / Semesterende

(Empfohlene) Voraussetzungen:
Basic knowledge in ecology and landscape ecology; beneficial to have completed the module(s) “Urban Ecology” WZ6407.

Inhalt:
Urban areas are major drivers of global environmental change, habitat degradation, changes in biodiversity, and the loss of vegetation biomass. These and many other factors emphasize the necessity to understand and examine how urbanization affects the interactions between humans, greenspaces, wildlife and the built environment. Furthermore, it opens questions around the possibilities for urban habitats and landscapes to support the enhancement of biodiversity, energy conservation, food security, public health and well-being.

This module explores the ecology and planning of urban areas and landscapes. We will discuss advanced concepts in urban ecology including: altered dispersal and colonization dynamics of urban plant and animal communities; effects of environmental stressors on plant and animal traits and their interactions; soil and substrate heterogeneity in community dynamics, ecosystem structure and function; water and energy flows in urban food production; changes in cultural ecosystem services and human values; and the spatial analysis of dynamic urban land use. The students will utilize methodological approaches in urban ecology research including collecting and analyzing biodiversity data, structure and functions of greenspaces data, analyzing remotely sensed spatial data, and harnessing citizen science and social media data.

We will emphasize the importance of understanding and analyzing how dynamic ecological and social forces shape urban ecosystems and the provision of ecosystem services. The module will benefit students interested in urban ecology and conservation science, and those interested in urban planning and urban environmental management.

Lernergebnisse:
On successful completion of the module, students are able to:
1. conceptually understand urban ecosystem dynamics, specifically the changes and the processes that underly ecosystem dynamics;
2. critically analyze the effects of environmental disturbances on urban ecosystem energy and nutrient flows, biodiversity, regeneration processes and the potential to deliver ecosystem services;

3. apply methods in the field and lab to measure and evaluate processes within terrestrial and aquatic urban systems, but also within social systems to analyze human perceptions and values underlying cultural services;
4. communicate critical insights into the potential consequences of ecological engineering strategies applied to managing different urban ecosystems and landscapes;
5. develop a research proposal to investigate novel questions in urban ecology and urban planning.

Lehr- und Lernmethoden:
The interactive module comprises a seminar (S) and an exercise (UE) / excursion (EX) to best combine lectures, case study analyses, group discussions, and presentations from guests and peers. The seminars will cover advanced concepts in lecture PowerPoint presentations but also through paper discussions and group work (3-5 students) on a range of topics (see above). Paired with a weekly topic, the exercises/excursions cover research methods that are based in experiential learning with foreseen excursions to field sites in Munich as well as laboratory work at TUM-WZW. Through field excursions and lab practical work, students will collect and analyze data to gain important methodological skills in conducting urban ecosystem and planning research.

Medienform:
PowerPoint, films, virtual lectures, virtual activities, data scripts

Literatur:
Barbosa, P. 2020. Urban ecology: its nature and challenges. CAB International, Boston, MA.
Brown, R. D. and Gillespie, T. J., 1995. Microclimatic Landscape Design: Creating Thermal Comfort and Energy Efficiency. John Wiley & Sons.
Carreiro, M M., Song, Yong-Chang and Wu, J. (eds.), (2008). Ecology, Planning and Management of Urban Forests. Springer: New York.
Craul, P. J., 1999. Urban Soils – Applications and Practices. John Wiley & Sons.
Ferrini, F., Konijnendijk van den Bosch, C., & Fini, A. (Eds.), (2017). Routledge handbook of urban forestry. London: Routledge.

Modulverantwortliche(r):
Egerer, Monika; Prof. Dr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Advanced Concepts and Methods in Urban Ecosystems (Übung, 3 SWS)
Egerer M [L], Egerer M, Pauleit S, Rahman M

Advanced Concepts and Methods in Urban Ecosystems (Seminar, 2 SWS)
Egerer M [L], Egerer M, Pauleit S, Rahman M

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2721: Agriculture Raw Materials and their Utilization | Agriculture Raw Materials and their Utilization [ARM&U]

Modulbeschreibungsversion: Gültig ab Wintersemester 2020/21

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The module grade is assessed by a written exam (60 min). The students show that they have understood the principles of biomass production for bioenergy use, biomass supply chains, and the different bioenergy systems. The written exam demonstrates the student’s ability to deal with questions, and calculations, complete figures or prepare sketches in regard to biomass production for bioenergy use.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
General understanding of natural science, mathematics and basics of technology.

Inhalt:
The targets for the module “Agriculture Raw Materials and their Utilization” are impart a basic understanding of the possibilities and limitations for the agricultural production of biomass for energetic and industrial uses and to provide an overview of ecological impacts of diverse biomass and bioenergy utilization pathways.
The module comprises a lecture which deals with the following topics:
- Production of agricultural biomass and the most important energy and industry crops
- Biomass chains and uses
- Diverse bioenergy systems
- Bioeconomy & biorefineries (related to Agricultural products)
Ecological impact assessment of biomass and bioenergy utilization.

Lernergebnisse:
At the end of the module students have acquired knowledge of the production and utilization of renewable resources from the agricultural and forestry sector.
They know how to analyze the performance and ecological impacts of different biomass supply and utilization chains. They can estimate the suitability of various crops for bioenergy use. The students have an insight in the physical and chemical basics of energy production from biomass and are able to apply related basic equations. They can compare different biomass combustion systems and attribute emissions. The students know the production pathways and properties of different biofuels for transportation and are able to estimate their future potentials. They understand the technological background of biogas production and can do basic designs of biomass supply and utilization chains using the example of biogas systems in agriculture.

Lehr- und Lernmethoden:
The lecture with integrated exercises and discussions will improve the understanding. During the lecture a power point presentation related to the lecture topics will be done from each student to improve the discussion in the different topics of the module.

Medienform:
Power point presentations, black board. Videos, Online Quiz.

Literatur:
Hijazi, O; Munro, S; Zerhusen, B; Effenberger, M. (2016): Review of life cycle assessment for biogas production in Europe. Renewable and Sustainable Energy Reviews (54), 1291-1300.

Modulverantwortliche(r):
Hijazi, Omar; Dr. rer. agr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2726: Assessment of Sustainability in Agriculture - Theory and Case Studies | Assessment of Sustainability in Agriculture - Theory and Case Studies

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The Assignment (Report+Assessment) is done as groupwork (2-3 students). As the report and assessment is based on a farm visit and to register presented details and understand the complexity of the system group working is necessary. The assignment shows the ability of the students to describe the farming system, to apply the developed criteria of sustainable agricultural practice, to assess the sustainability of farm as a system and to give recommendations for an improved development.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
Sustainability in farms context, principles of sustainability, criteria, inquiry strategies, indicator and indicator concepts, assessment and benchmarking.
Application to farming systems and farms at different level of intensification; case studies based on excursions: arable farming, organic vs. conventional farming, vegetable production in arable farms, grassland based farming system, dairy farming, suckling beef production.

Lernergebnisse:
On successful completion of the module students are able to understand the idea of sustainability in the context of farms. They will have the ability to create criteria and indicators to assess sustainability of farms and to built up benchmarking systems. The students can describe farming

systems and are able to evaluate the sustainability using criteria and indicators and to document them in a report.

Lehr- und Lernmethoden:
Lectures with presentation of principles and systematics
Reading papers
Group work, mind mapping, meta plan technical to document discussion results.

Medienform:
Power Point, Flip Chart, Pin wall, Metaplan technic

Literatur:
Tba

Modulverantwortliche(r):
Dipl. Ing. Max Kainz; Dr. Hans-Jürgen Reents - Lehrstuhl für Ökologischen Landbau und Pflanzenbausysteme, Liesel Beckmann Str. 2, 85354 Freising, 08161/71 - 3778, kainz@wzw.tum.de, reents@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Assessment of Sustainability in Agriculture- Theory and Case Studies
Hans-Jürgen Reents, Max Kainz
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2736: Analytical Characterization of Soil Resources | Analytical Characterization of Soil Resources

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The students hand in a research paper (10-15 pages), in which they present and discuss the analytical data obtained by own laboratory characterization of soil samples that were collected by the students themselves during a guided exercise in the field. The research paper is accompanied by an oral presentation (15-20 min) to assess the scientific communication skills of the students. For the final mark, the research paper accounts for 75% and the oral presentation for 25%.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
The successful completion of the module "Introduction to Soil Science" (WZ2733) or equivalent skills are required.

Inhalt:
• Sampling and sample preparation
• Lab analyses: texture, density, water conductivity, organic and inorganic carbon, nitrogen, soil organic matter
decomposition, pH, cation exchange capacity, Fe oxides, phosphate retention;
• Data interpretation

Lernergebnisse:
The students are able to apply their knowledge of soils, as achieved in the module “Introduction to Soil Science”, to
the most important physical, chemical and biological processes in soils. They are able to choose the adequate

laboratory method to answer a certain question on soil management. They know how to do sampling, sample
preparation and laboratory work. They can interpret laboratory data and know, which conclusions can be made and
which conclusions cannot be made. The students are able to communicate their results in a written and an oral
manner.

Lehr- und Lernmethoden:
For every step, the lecturers give the theoretical background. Afterwards, every step is done by the students
themselves, guided by the lecturers and the laboratory staff: sampling, analyses, data interpretation.

Medienform:
Lecture: presentation notes; sampling: field equipment; laboratory course: laboratory instruments

Literatur:
will be given in the course

Modulverantwortliche(r):
Schweizer, Steffen; Dr. rer. nat.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Analytical characterization of soil resources: Laboratory course (Übung, 3 SWS)
Prietzel J, Schweizer S, Bucka F, Göttlein A, Kolb E, Laniewski R, Leemhuis S

Analytical characterization of soil resources: Lecture (Vorlesung, 1 SWS)
Schweizer S
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2757: Advanced Environmental and Natural Resource Economics | Advanced Environmental and Natural Resource Economics

Modulbeschreibungsversion: Gültig ab Sommersemester 2017

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The examination consists of a written exam (90 min), a presentation (20 min) and a term paper (around 10 pages). The written exam shall give proof that the lecture content was understood and that it can be applied in exemplary excercises. Both the presentation and the term paper shall analyse a lecture topic in detail and place it in the economic environment. Weighting is as follows: 50 % written exam, 40 % term paper, 10 % presentation.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Environmental and Natural Resource Economics (recommended)

Inhalt:
Dynamic optimization; Theory of optimal extraction of renewable and non-renewable resources; Theory of joint production; Application of game theory to resource management; Optimal growth and green accounting

Lernergebnisse:
At the end of the module students have a profound knowledge of the economics of resource problems. They can derive the optimal time path to use renewable and non-renewable resources. They can explain how resources can be incorporated in the theory of optimal growth and how they can be accounted for in welfare and sustainability measurement. They can explain how some welfare enhancing effects are produced as a side effect of production systems. They are able to apply resource economic theory to real life resource problems. They know how to apply the basic concepts of game theory and how these can be used to explain the (im)possibilities of reaching international environmental agreements.

Lehr- und Lernmethoden:
Lectures will be used to teach the theoretical material. Exercises will be used to apply the theory taught in the lectures to solve problems and to facilitate a better understanding of the subject matter. In order to enable students to critically reflect on lecture topics, interactive elements are integrated (e.g. group work, case study).

Medienform:
Lecture notes, Excel

Literatur:
will be told in the lecture

Modulverantwortliche(r):
Sauer, Johannes; Prof. Dr. agr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Advanced Environmental and Natural Resource Economics (Vorlesung, 4 SWS)
Sauer J [L], Canessa C, Mennig P, Villalba Camacho R
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ1308: Creation of a Life Cycle Assessment Study Using LCA Software | Creation of a Life Cycle Assessment Study Using LCA Software

Modulbeschreibungsversion: Gültig ab Sommersemester 2020

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 3

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The examination consists of an LCA report of around 20 pages which is the means to evaluate whether the students are able to create a life cycle assessment (LCA) using a special LCA software. After modelling of an own LCA case study the students write an LCA report based on a learning process and describe the used methodology for the life cycle assessment. The results of the LCA case study have to be analyzed and discussed in the report.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in Life Cycle Assessment, e.g. WZ4206 Material Flow Management and Application or WZ0156 Rohstoffmärkte, Ökobilanzierung, Waldzertifizierung (previous name Rohstoffmärkte und Qualitätssicherung), natural science (biology, chemistry, ecology, physics); understanding for agricultural and forestry production processes as well as for engineering science and social/cultural aspects.

Inhalt:
The students acquire detailed and differentiated knowledge about the following topics:
- need of life cycle assessment
- procedure of life cycle assessment
- material and substance flow analysis including life cycle inventory
- life cycle impact assessment
- interpretation of LCA results

- development of strategies and measures for conducting and reporting of a life cycle assessment study

Lernergebnisse:
By the means of the module the students are able to:
- define a system boundary and functional unit when creating a LCA study
- create processes and flows and how to link them in product systems using LCA software
- create a project with different scenarios and the relationships between different processes
- create their own processes and flows using primary data
- apply the assessment methods of indicator systems and life cycle assessment
- evaluate the project (using different LCIA methods)
- create an LCA Report individually

Lehr- und Lernmethoden:
Concerning teaching methods, lecture and presentation parts provide the extended theoretical foundation of conducting life cycle assessment. The OpenLCA software will be used for modelling and therefore installed on the students' laptop (optional) or they can work directly on a TUM-PC. LCA case studies in forestry and agricultural productions are introduced to the students and worked out in the class. A case LCA study will be examined systematically with the students with different scenarios. At the end, the students have to create their own LCA case study out of the forestry or agricultural field including the subsequent processing industries and to document all the steps done in a report including the methodology, results and discussion. The students are supervised by tutorials by the lecturers.

Medienform:
PowerPoint presentation, lecture sheets, case studies, OpenLCA software.

Literatur:
Klöpffer, W., Curran, M. (eds.). 2014 - 2017. LCA Compendium – The Complete World of Life Cycle Assessment. Book Series. Springer.
Klöpffer, W., Grahl, B. 2009. Ökobilanz (LCA): Ein Leitfaden für Ausbildung und Beruf. Wiley-VCH, Weinheim. 426 pp.
Brunner, P.H. Rechberger, H. 2016. Handbook of Material Flow Analysis: For Environmental, Resource, and Waste Engineers. Taylor & Francis Inc; 2. Revised Edition. 453 pp.
EC-JRC – European Commission - Joint Research Centre - Institute for Environment and Sustainability. 2010. International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. First edition March 2010. EUR 24708 EN. Luxembourg. Publications Office of the European Union. 394 pp.
Baumann, H., Tillman, A.-M. 2004. The hitch hiker's guide to LCA an orientation in life cycle assessment methodology and application. Lund, Studentlitteratur.

Modulverantwortliche(r):
Hijazi, Omar; Dr. rer. agr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Creation of a Life Cycle Assessment Study Using LCA Software (Seminar, 2 SWS)
Hijazi O [L], Hijazi O
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ1590: Climate Change Economics | Climate Change Economics

Modulbeschreibungsversion: Gültig ab Wintersemester 2014/15

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 60	**Präsenzstunden:** 90

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
There will be a written exam (Klausur) of 90 minutes at the end of the semester. The students will be asked to demonstrate, within the stipulated amount of time using predefined methods and resources, their ability to outline the challenges climate change poses to regulators, propose pragmatic solutions and strategies as well as ways of implementing them. This would be based on the competences acquired from the relevant literature of economic modeling, theories of climate change and their understanding from the course content. The written exam is an appropriate assessment method to evaluate the degree to which the students understand the theoretical framework of climate change implications as well as provides an opportunity for them to put forward arguments based on existing theory.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge:
• Micro Economics (Welfare Economics)
• Environmental Economics
• Resource Economics

Inhalt:
This course covers the trends in current and future climate change and their effects on economic and social outcomes.

The lectures are divided into ten sessions:
1. Introduction to the Basic Science of Climate Change
- The students will learn about the scientific themes of global climate change and the economic dimension of the phenomenon.

2. Basic Economics
- The students will learn how a market economy can be efficient and socially optimal as well as about the prospects of externality.
3. Optimal Emission Levels
- The students will learn of the optimal abatement path and its uncertainty with respect to damages as well as Integrated Assessment Models (IAMs).
4. Intra-generational equity in climate policy
- The students will learn about how to account for equity across space (intergenerational equity) when deriving optimal emission levels.
5. International Environmental Agreements
- The students will learn about the dynamics behind common strategies towards achieving some form of optimal emission level.
6. Policy Instruments
- The students will learn about diverse instruments such as quality-based approach and Pigouvian Tax.
7. Regulation via Prices vs. Quantities
- The students will learn what circumstances will a regulator prefer prices over quantities and vice versa.
8. Credit-based Mechanisms
- The students will learn about how to deal with countries that do not want to commit, but have a high potential for low-cost reductions.
9. German Climate Policy
- The students will learn about German Climate Action - strategies and policies
10. European Union Emission Trading Scheme - EU ETS

Lernergebnisse:
After successfully completing the module, students are able to:
• Evaluate and formulate economic models related to climate change.
• Apply theoretical model to climate change regulations as well as policies that affect emission levels.
• Analyze the complexity, uncertainty and possibilities associated with optimal emission level.
• Apply appropriate instruments for optimal emission level that are efficient and cost-effective.
• Understand climate negotiations (club) and climate action strategies are currently being implemented.

Lehr- und Lernmethoden:
The course mainly consists of lectures (4 SWS). The lecture will provide a foundation upon which to build the ensuing discussions on climate change issues from an economic perspective. The content of the module is expected to be transferred to the students in an interactive learning manner were, among others, emission reduction instruments are scrutinized. This encourages the students to independently and self-reliantly study the literature guided by a structured framework.

Medienform:
PowerPoint, flipchart, internet portals, online reports etc.

Literatur:
Bréchet, T., & Eyckmans, J. (2009). Coalition theory and integrated assessment Modelling: Lessons for climate governance. Global Environmental Commons: Analytical and Political Challenges in Building Governance Mechanisms.
Rohling, M., & Ohndorf, M. (2012). Prices vs. quantities with fiscal cushioning. Resource and Energy Economics, 34(2), 169-187.
MacKenzie, I. A., & Ohndorf, M. (2012). Optimal monitoring of credit-based emissions trading under asymmetric information. Journal of regulatory economics, 42(2), 180-203.
Hake, J. F., Fischer, W., Venghaus, S., & Weckenbrock, C. (2015). The German Energiewende–history and status quo. Energy, 92, 532-546.
Climate Action Plan 2050 Principles and goals of the German government's climate policy. https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/klimaschutzplan_2050_en_bf.pdf
EU ETS Handbook. https://ec.europa.eu/clima/sites/clima/files/docs/ets_handbook_en.pdf

Modulverantwortliche(r):
Sauer, Johannes; Prof. Dr. agr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Climate Change Economics (WZ1590) (Vorlesung, 4 SWS)
Sauer J [L], Canessa C, Frick F
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2730: Climate Change - Science, Impacts and Adaptation, Mitigation | Climate Change - Science, Impacts and Adaptation, Mitigation

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Due to Corona, the form of examination has changed as follows.
Assessment consisting of excercises. In a written test (Klausur, duration 60min, 60% of the module grade) the student is expected to demonstrate that he/she has understood the physical basis of the climate system and that they can identify the drivers of climate change.
In three graded exercises the student shows that he/she is able to apply his/her knowledge to develop adaptation and mitigation measures and to argue in discussions on climate change issues. The students prepare a video in groups including a role play of a panel discussion to develop their persuasive and critical skills as organizers and presenters, they become more familiar with political decision-making processes. The video is presented and discussed with all students participating. The grade for the seminar counts 40% of the module it consists of three equally weighted grades for each exercise.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in meteorology, physics, biology.

Inhalt:
Based on the newest IPCC report (AR 5) the theoretical background on the physical science basis of climate change, theory and practical application of adaptation and mitigation measures in biological, physical and chemical systems will be presented. In a related seminar, selected topics will be intensified in case studies. TUM as a NGO in the UNFCCC process offers an optional possibility also for students to take part in COP and related negotiations.

Lernergebnisse:
After this module, the students can understand the physical basis of the climate system, identify all drivers of climate change and falsify common arguing of "climate sceptics". They can summarize observed changes in the climate system as well as impacts in divers systems and regions. They are able to assess cross-sectorial impacts of climate change in selected areas, to evaluate and develop adaptation and mitigation measures and strategies in biological, physical and chemical systems including an analysis of their effectiveness and cost-effectiveness.

Lehr- und Lernmethoden:
Lecture on physical basis of the climate system, impacts of climate change and important mitigation strategies. In the seminar group presentations of various topics regarding adaptation and mitigation of climate change will be presented as case studies. Optional excursion to UNFCCC meeting if applicable.

Medienform:
Lecture with PowerPoint Presentation, reader and exercises. Group work in seminar including problem driven case studies and student presentations, excursion.

Literatur:
IPCC (2013) Fifth Assessment Report of WGI, II, III. Houghton (2015) Global warming, the complete briefing. Most recent scientific literature.

Modulverantwortliche(r):
Rammig, Anja; Prof. Dr. rer. nat.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Ecological, social and economic aspects of CC impacts, adaptation and mitigation on different scales (Seminar, 2 SWS)
Estrella N [L], Menzel A, Estrella N, Ghada W

Climate Change - The complete briefing (Vorlesung, 2 SWS)
Rammig A [L], Rammig A
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

POL62200: Energy Transformation | Energy Transformation

Modulbeschreibungsversion: Gültig ab Wintersemester 2017/18

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
For this module, evaluations will be based on written work and a presentation. The written assignment for the module will be of a length of approximately 20-25 pages. The topic of the module paper is to be developed in consultation with the seminar leaders and will deal with a specific topic of the seminar (energy transformation) and its technological, political, and social dimensions. The paper will be introduced with a precise question and then analyzed in depth. The methodology of research needs to be indicated and a comprehensive bibliography included. Students will be expected to prepare and give a presentation of at least 20 minutes tied to a session topic. Group presentations of up to three students are possible as long as individual contributions are discernible.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Ring lecture „Politics & Technology“

Inhalt:
For a variety of reasons, including energy security, environment and climate concerns, and the potential to develop new technologies and processes, cities, countries and entire regions are pursuing low-carbon energy transitions. Understandings of what the best approach to a low carbon energy transition is, however, vary widely. The extent to which energy transitions are occurring in various sectors (power, heating/cooling, transportation) differs significantly. Why is this the case? What factors support or inhibit the scaling-up of policy solutions? What are the challenges associated with large scale energy system transformations? How similar or different are energy system transformations to other major transformations which have occurred in the past or which may need to occur in the future? This module will consider these and other questions in the context of Germany, at the European level and internationally.

Lernergebnisse:
After participating in this module, students will understand the arguments underpinning decisions to pursue low carbon energy transitions, how low carbon energy transitions are affected by broader economic, technological, and political factors, and the ways in which actors at the local, national, or international level may act to promote or inhibit change. They will have gained insights into system transformation thinking, understand aspects of the production, distribution and utilization of energy and their interplay; apply methods of comparative policy analysis to energy policy in different political systems; be able to identify challenges of policy-making in national politics and the European multi-level system; to critically analyze energy policy in Germany, Europe, and internationally (for example in China, Japan, India, the United States as well as at the global level); to analyze the factors determining German, European, and international energy politics, and to evaluate the effects of different energy policy governance instruments (like legal regulation, planning, incentive design, taxes, subsidies, etc.).

Lehr- und Lernmethoden:
The module is offered in the form of two seminars, each dealing with different, but complementary thematic areas. One will be focused more on the transition of the energy systems in Germany and Europe while the other will concentrate more on the international and global level. To obtain a deeper understanding of the module’s topics a combination of independent work and general discussion will be used in the seminar. Seminars will include both direct input from the instructor and a wide variety of active learning methods. During the seminars, there will be in-depth discussions and inputs by students. Concrete examples will be used to practice, analyze, and evaluate the material which has been presented. Both the technical and scientific aspects of issues as well as their political and social implications will be discussed. The presentations developed and given by the students and ensuing discussions will contribute to the students' understanding of the seminar materials and instructor's inputs.

Medienform:
Online-Reader, PowerPoint

Literatur:
A reader of seminar texts with up-to-date and cutting edge scienitific literature will be made available at the start of the semester.

Modulverantwortliche(r):
Schreurs, Miranda; Prof. Dr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
(POL62200) Energy Transformation (Seminar 1 + 2) (Seminar, 4 SWS)
Cetkovic S (Mohammed N)
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WI000286: Environmental and Natural Resource Economics | Environmental and Natural Resource Economics

Modulbeschreibungsversion: Gültig ab Sommersemester 2017

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning success will be assessed by a written exam (120 minutes)..
By answering the questions students show that they are able to understand the economic view of environmental and resource problems. Furthermore students show that they are able to compare and evaluate alternative economic instruments (e.g. taxes, emission permits, payments for environmental services). They show their ability to apply environmental policy instruments and valuation methods to specific problems. Finally students demonstrate that they are able to conduct and interpret economic cost-benefit analyses.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
A basic knowledge in Microeconomic theory is recommended

Inhalt:
a) Economic growth and the environment
b) Economic analysis of environmental problems
c) Role of institutions and liability rules
d) Analysis of environmental economic instruments
- Command and control measures
- Pollution taxes
- Emission trading
- Payments for environmental services
e) Valuation methods for environmental goods
f) Cost-benefit analysis.

Lernergebnisse:
At the end of the module the students are able to understand the economic view of environmental and resource problems. They know alternative economic instruments, e.g. taxes, emission permits, payments for environmental services and how they work and are able to compare them regarding their economic efficiency. They know and can apply specific valuation methods to attach a monetary value to environmental effects and conduct and interpret economic cost-benefit analyses.

Lehr- und Lernmethoden:
The module will be held in the form of lectures which are partially combined with group discussions and exercises. The main learning objective is here to understand the economics of environmental policy. Lectures are a format suitable to convey theoretical knowledge about the welfare implications of policy interventions. Integrated exercises will help students to apply acquired knowledge to concrete problems and derive economically sound answers.

Medienform:
PowerPoint

Literatur:
A digital reader consisting of various textbook chapters and journal articles will be put on Moodle for each chapter of the course.

Jaeger, W.K. (2005): Environmental Economics. Island Press.
Mankiw, N.G. and M.P. Taylor (2011): Microeconomics. 2nd Edition. South Western.
Perman, R., Y. Ma, J. McGilvray, M. Common (2003): Natural Resource and Environmental Economics. 3rd Edition. Pearson Education Limited.
Tietenberg, T. and L. Lewis (2010): Environmental Economics & Policy. Prentice Hall.

Modulverantwortliche(r):
Glebe, Thilo; PD Dr. habil.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Environmental and Natural Resource Economics (WI000286) (Vorlesung mit integrierten Übungen, 4 SWS)
Glebe T
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WI001204: Economics of Water Use, Regulation and Markets | Economics of Water Use, Regulation and Markets

Modulbeschreibungsversion: Gültig ab Wintersemester 2018/19

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
In a written examination at the end of the semester of 120 mins (in class), students will demonstrate the ability to understand and analyze concepts and methodological approaches related to water resource management using economic terminology, and the ability to apply mathematical tools to solve specific calculus problems. A written exam is necessary in order to assess the holistic understanding and analytical competencies of the students. Students will have to option to give an in-class presentation (~15 min) of a paper related to water resource economics that they will choose from a list of references provided by the instructor. The in-class presentation (mid-term assignment) is optional and improves the final grade by 0,3. The extra credit from the in-class presentation cannot be transferred in the case of re-examination.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Students taking this course should be familiar with the basics of microeconomics as well as mathematical economics (derivatives, basic function integrals and graphs). However, all necessary concepts will be introduced before application.

Inhalt:
The course will examine the incentives that lead to overexploitation of water recourses and how altering these incentives can promote socially optimal use patterns. The course will also provide the students with a set of analytical tools that can be used to work on water issues or natural resource issues more broadly.
Those topics are:
1. Introduction and Economics Basics
2. Agricultural Water Use

(water rights, agricultural water use efficiency and productivity, land allocation, technology choice, environmental quality)
3. Residential Water Use
4. Water, Land Use and Environmental Aspects of Biofuel Production
5. Other Approaches to Value Water
(hedonic modelling, experimental economics, nonmarket valuation approach)
6. Intertemporal and Interregional Aspects of Water
7. Water Markets Around the World
(Europe, China, USA)

Lernergebnisse:
This course is designed to introduce students to the subject of water economics.
Upon successful completion of the module, students will be able to:
• understand the basic concepts and economic models used to study the economics of water resources issues.
• select and apply the appropriate economic model to solve water policy problems as for example producer's profit or consumer's utility maximization.
• provide economic intuition for mathematical answers to water management problems.
• apply models to address a wide range of water resource problems and assess the economic effects of decision making process at different levels based either on the water demand or the water supply side of the economy.
• critique journal articles pertaining to economics of water resources.

Lehr- und Lernmethoden:
Theoretical concepts and example exercises will be given by the lecturer on the blackboard and by PowerPoint presentations to build the required knowledge base in water resource economics. Q&A sessions at the beginning of each lecture will be provided to recapitulate the previous lecture. In addition, under the supervision and help of the lecturer, in-class application exercises will be used to create real-world water management problems for which students in randomly assigned groups will create and solve problems. Discussion of relevant scholarly articles and literature will be used to aid understanding of the topic covered.

Medienform:
Presentation slides, Blackboard, hand-outs, Moodle course to provide materials (pdf of papers to read)

Literatur:
Auffhammer, M. et al., "The Value of Supply Reliability in Urban Water Systems," Journal of the Association of Environmental and Resource Economists, Working paper.
Caswell, M. & D. Zilberman, "The Effects of Well Depth and Land Quality on the Choice of Irrigation Technology," American Journal of Agricultural Economics 68(1986): 798-811.
Chong, H. & D. Sunding, "Water Markets and Trading," Annual Review of Environment and Resources 31(2006): 239-264.

Gisser, M., “Groundwater: Focusing on the Real Issue,” Journal of Political Economy 91(1983): 1004-1027.
Green, G. et al., “Explaining Irrigation Technology Choices: A Microparameter Approach,” American Journal of Agricultural Economics 78(1996): 1064-1072.
Renwick, M. & R. Green, “Do Residential Demand Side Policies Measure Up? An Analysis of Eight California Water Agencies,” Journal of Environmental Economics and Management 40(2000): 37-55.
Zilberman, D. et al., “Changes in Water Allocation Mechanisms for California Agriculture,” Contemporary Economic Policy 12(1994): 122-133.

The list will be expanded and updated using material from a variety of textbooks and journal papers corresponding to each of the topics.

Modulverantwortliche(r):
Prof. Dr. Johannes Sauer Jo.sauer@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Economics of Water Use, Regulation and Markets (WI001204) (Vorlesung, 4 SWS)
Sauer J [L], Vrachioli M
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ0228: Exercises in Precision Agriculture and Plant Phenotyping | Exercises in Precision Agriculture and Plant Phenotyping

Modulbeschreibungsversion: Gültig ab Sommersemester 2022

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The examination uses the format of Report (project report + presentation), in which students should demonstrate that they are able to apply the gained skills to address certain questions in research or applications, in the context of (but not limited to) precision agriculture and plant phenotyping. The final grades are calculated from the following elements:
- On the topic of choice, each group of students (e.g., 3-4 persons but can also be solo) writes a project report (8-10 pages of A4 single line format, excluding references) (75% of the total grade), and
- Each group presents project results in 15 min following 5 min discussion (25% of the total grade).

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
- Knowing the basics of scientific programming (e.g., R, Matlab) is recommended.
- Knowledge gained in the course module "Precision Agriculture" is recommended, but not mandatory.

Inhalt:
The module aims to transfer the practical methods and skills of using novel technologies for precision agriculture and plant phenotyping. Main topics include:

1. cameras, sensors, and integrated systems used in precision agriculture and plant phenotyping;
2. basics of using Matlab, R, and other related software packages;
3. drone (UAV) operation, image data acquisition and analysis pipeline;
4. spectrometer operation, plant and soil spectral measurements, and spectral data analysis;
5. digital image analysis methods and software packages;

6. GIS tools for spatial data analysis and visualization;
7. satellite imagery data acquisition, processing, and analysis;
8. detection of plant biotic and abiotic stresses using different sensors;
9. measuring field spatiotemporal variability and crop yield;
10. data science methods in precision agriculture and plant phenotyping;

Lernergebnisse:
Upon completion of the module, students will be able to:
- understand the basics of characterizing plant traits and crop field variability using non-destructive methods;
- apply basic sensors and software packages (e.g. R, Matlab) in practices;
- evaluate the potentials and limitations of different sensors and data science methods (e.g. for image segmentation and classification);
- design sensing and data analysis pipelines for solving practical problems;
- develop critical and systematical thinking skills;
- to present their results in a clear and comprehensible manner to an audience

Lehr- und Lernmethoden:
- The module delivers the practical skills of precision agriculture and plant phenotyping through demonstrations of operational and analytic methods, hands-on practices, and computer exercises.
- Students actively participate in the exercises and discussion, and write learning journals to reflect the critical aspects in the exercises, e.g., application potentials and limitations of methods.
- Students conduct exercises through teamwork, write reports on topics of choice, and present the results and discuss with classmates.

Medienform:
Zoom, Scripts, PowerPoint

Literatur:
- Current literature related to the topics

Modulverantwortliche(r):
Yu, Kang; Prof. Dr. rer. nat.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Precision Agriculture (Exercises) (Übung, 4 SWS)
Yu K
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ1876: Entrepreneurship in der Agrar- und Gartenbauwirtschaft | Entrepreneurship in the Agricultural and Horticultural Industry

Modulbeschreibungsversion: Gültig ab Wintersemester 2018/19

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Die Modulprüfung besteht aus einer 120-minütigen schriftlichen Klausur. Dabei wird das ganzheitliche Verständnis und die Darstellungskompetenz hinsichtlich der theoretischen und konzeptionellen Ansätze von Entrepreneurship geprüft.
Darüber hinaus werden die Studierenden die Venture-Gründungsprozesse und Risiken in Innovations- und Produktentwicklung analysieren, unternehmerische Kooperationen in der Agrar- und Gartenbauwirtschaft beurteilen, und dazu gehörige Management- und Organisationsstrukturen gestalten.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Grundlagen der Mikroökonomie, Grundlagen der Marktlehre (Bachelor Studiengang)

Inhalt:
Das Modul vermittelt und diskutiert die Prinzipien, theoretischen Ansätze und Bedeutungen von Entrepreneurship-Orientierungen, um die Anwendung von Innovationen und unternehmensgründungbezogenen wirtschaftlichen Tätigkeiten in der Agrar- und Gartenbauwirtschaft zu unterstützen. Die Lehrveranstaltung schließt die folgende Themen ein:

• Prinzipien des Entrepreneurship und Entrepreneuership-Orientierungen in der Agrar-und Gartenbauwirtschaft
• Innovation- und Produktentwicklungsprozeß und dazu gehörige unternehmerische Chancen und Risiken
• Unternehmerische Strategien und Kollaborationen im Venture-Gründungsprozess

• Methodische Ansätze (z.B. "attribute mapping", "the strategy canvas", verschiedene ökonometrische Ansätze) zur Erklärung und Evaluierung von entrepreneurshipbezogenen Tätigkeiten und Venture-Gründungsprozeßen
• Nachhaltiges Entrepreneurship

Lernergebnisse:
Nach erfolgreichem Absolvieren des Moduls sind die Studierende in der Lage:
• die Prinzipien von Entrepreneurship und Unternehmensgründung in der Agrar- und Gartenbauwirtschaft zu verstehen,
• qualitative und quantitative Methoden zur Erklärung und Beurteilung von Entrepreneurship bezogene Aktivitäten zu verwenden,
• die Risiken und Chancen in Innovations- und Produktentwicklung zu analysieren,
• Kooperationen und Strategien in Entrepreneurship und Unternehmensgründung zu beurteilen, und
• Venture-Gründungsprozesse und dazu gehörige Management- und Organisationsstrukturen zu entwickeln

Lehr- und Lernmethoden:
Mit Hilfe von Vorlesungen werden die theoretischen Ansätze und Konzepte von Entrepreneurship und Unternehmensgründungsprozess vermittelt. Gruppenarbeiten und Präsentationen dienen dazu praxisnah Probleme und Lösungsvorschläge beschreiben und bearbeiten zu können.

Medienform:
Präsentationen, Fallbeschreibungen, Skripte

Literatur:
Ardichvili, A., Cardozo, R., & Ray, S. (2003). A theory of entrepreneurial opportunity identification and development. Journal of Business Venturing, 18: 105–123.
Berti, G. and Mulligan, C. (2016). Competitiveness of Small Farms and Innovative Food Supply Chains: The Role of Food Hubs in Creating Sustainable Regional and Local Food Systems. Sustainability, 8 (616): 1-31.
Bolton, W.K. and Thompson, J.L. (2000). Entrepreneurs: Talent, Temperament, Technique. Butterworth Heinemann, Oxford.
Casson, M., (2003). The Entrepreneur, New York, NY: Edward Elgar Publishing.
Dunkelberg, et al. (2013). Do entrepreneurial goals matter? Resource allocation in new owner-managed firms. Journal of Business Venturing, 28: 225–240.
Grichnik, D. (2006). International Entrepreneurship: Entscheidungs- und Risikoverhalten von Unternehmensgründern und Venture-Finanziers in kulturellen Kontexten — Theoriebildung und empirische Analysen. Berlin: Duncker & Humblot-Verlag.
Howieson, et al. (2014). New Product Development in Small Food Enterprises. Journal of New Business Ideas & Trends, 12(1): 11 - 26.
Joakim, T. et al. (2016). Business model innovation in the agri-food sector: a literature review. British Food Journal, 118(6): 1462-1476.

Kim, W.C. and Mauborgne, R. (2005). Blue Ocean Strategy, Harvard Business School Press: Boston.
Shane, S. and Venkataraman, S. (2000). The Promise of Entrepreneurship as a Field of Research, Academy of Management Review, 25(1): 218–228.
McGrath, R. G. and MacMillan, I. (2000).The Entrepreneurial Mindset: Strategies for Continuously Creating Opportunity in an Age of Uncertainty.
Mirzaeia, O. et al. (2016). Product and Marketing Innovation in Farm-Based Businesses: The Role of Entrepreneurial Orientation and Market Orientation. International Food and Agribusiness Management Review, 19(2): 99-130.
Morris, et al. (2017): Farm diversification, entrepreneurship and technology adoption:Analysis of upland farmers in Wales. Journal of Rural Studies 53: 132-143.
Shadbolt, M.N. and Olubode-Awosola, F. (2016). Resilience, Risk and Entrepreneurship. International Food and Agribusiness Management Review, 19(2): 33-52 .
Sporleder, et al. (2008). Innovation in Food Products: First-mover Strategy and Entropy Metrics. International Food and Agribusiness Management Review, 11(3): 139-164.
York, G.J. and Venkataraman, S. (2010). The entrepreneur–environment nexus: Uncertainty, innovation, and allocation. Journal of Business Venturing, 25: 449–463.
Die Liste wird anhand von weiteren thematisch relevanten Büchern, Zeitschriftenartikeln und aktuellen Themen aktualisiert

Modulverantwortliche(r):
Getachew Abate Kassa getachew.abate@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2724: Emission Control in Land-Use and Animal Husbandry | Emission Control in Land-Use and Animal Husbandry

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 105	**Präsenzstunden:** 45

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The oral examination will be held either as an individual or a group examination. If more than 40 students sign in for the examination the oral examination can be done in a written form. The duration of the oral examination is 20 min per person. The Students are able to describe typical agricultural production, the environmental impact and the measurement procedures to quantify and to qualify these impacts. On that basis they are able to weigh the advantages and disadvantages of possible measures of air pollution in agriculture.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Interest in the field of agriculture; willingness to learn about the causal relation between agriculture and emission control.

Inhalt:
Upon completion of the module, students are able to understand and analyze:
• the principle of agriculture in plant and livestock production on a basic level
• the main emissions caused by agricultural processes on a deeper level
• interactions of agricultural processes with the emission
• the environmental effects of these emission
• the measurement procedures to qualify and quantify agricultural emissions
• possibilities of emission abatement in land-use and animal husbandry.

Lernergebnisse:
At the end of the module students are able to:
- understand the interrelation between local causes and global impacts,

- apply the comprehension of basic physical, chemical, and biological principles to phenomena in practice,
- evaluate measurement techniques in a qualitative manner,
- evaluate measures and techniques of environment protection;
- understand the interrelation between animal husbandry and air pollution control,
- derive adequate measures of environmental protection.

Lehr- und Lernmethoden:
Lecture, practice course.

Medienform:
PowerPoint-slides, short clips.

Literatur:
Tba

Modulverantwortliche(r):
Dr. Stefan Neser – Bavarian State Research Center for Agriculture; Institute for Agricultural Engeneering and Animal Husbandry; Voettinger Strasse 36, 85354 Freising, 0049 8161 713566; stefan.neser@lfl.bayern.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Emission control in Land-Use and Animal Husbandry (Vorlesung, 3 SWS)
Lichti F, Neser S
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2732: Environmental Monitoring and Data Analysis | Environmental Monitoring and Data Analysis

Modulbeschreibungsversion: Gültig ab Wintersemester 2020/21

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 80	**Präsenzstunden:** 70

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Aufgrund des Pandemiegeschehens hat der/die Studierende auch die Möglichkeit, an einer beaufsichtigten elektronischen schriftlichen Fernprüfung (Aufsicht mit Zoom, 180 min.) teilzunehmen (Onlineprüfung: WZ2732o). Diese Prüfung wird zeitgleich parallel in Präsenz angeboten (WZ2732).

Upon completion of the module, the students have a profound understanding of key aspects of environmental monitoringand are able to choose appropriate as well as to efficiently run environmental measurements, to reproducibly analyze acquired data and to clearly communicate results of environmental measurements.
This ability should be demonstrated by writing a research paper following standards of reproducible research based on different aspects of environmental monitoring and data analysis with R. For the research paper, either available data or data measured during the module should be used and be analyzed in respect to defined hypotheses; developed R code has to be provided too.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in R is recommended.

Inhalt:
1 Environmental monitoring including principles, techniques and management issues used in environmental monitoring and assessment; Observing, recording, communicating and archiving collected data and providing it to project stakeholders in order to identify sustainable and responsible environmental practices.
Optional: short course Aerobiology, GAW program, visit of companies

2 Environmental data analysis
Introduction to data analysis with R; Principles of reproducible research and implementation with R; Pipelines for environmental data analysis from obtaining data via cleaning and transforming to modelling and visualization with modern R; Coverage of data retrieval from different storage types for climate, proxy, phenology, and other data (text-based, netCDF, data bases); Modeling and visualization as complementary strategies for hypothesis-driven data analysis, based on published research from different fields of environmental sciences.

Lernergebnisse:
After this module, the students can plan, implement and run environmental measurements. They are able to efficiently analyze environmental data sets, including download and import of data sets and visualization and modelling with R.

Lehr- und Lernmethoden:
Course 1 consists of a practical course in the laboratory and in the field where students will work in small teams on applied case studies and exercises related to environmental / meteorological monitoring. Course 2 then offers combined lecture and exercise sessions at the PC lab on how to efficiently analyze those environmental data sets of course 1.

Medienform:
PowerPoint Presentation, Field work, Interactive documents for data analysis

Literatur:
Beginner level tutorials for Swirl (http://swirlstats.com/)

Modulverantwortliche(r):
Responsible for Module: Prof. Dr. Annette Menzel - Professur für Ökoklimatologie Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, 08161/ 71-4740, menzel@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Environmental monitoring and data analysis; ecological data analysis (Vorlesung mit integrierten Übungen, 3 SWS)
Menzel A [L], Buras A, Krause A, Meyer B

Environmental monitoring and data analysis; ecological monitoring (Vorlesung mit integrierten Übungen, 2 SWS)
Menzel A [L], Lüpke M
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

BGU62039: Fallstudien nachhaltiger Quartiers-, Stadt- und Infrastrukturentwicklungen | Case Studies of Sustainable Urban Developments and Infrastructure [FNQSI]

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Die Prüfungsleistung wird durch die Erstellung einer wissenschaftlichen Arbeit in Form eines Essays (etwa 5-7 Seiten) erbracht. Dieses wird in Gruppen von 2-3 Student*Innen erarbeitet. Zum Ende des Semesters werden die Ergebnisse in einem benoteten Kurzvortrag präsentiert und abschließend besprochen.
Dabei soll nachgewiesen werden, dass die Student*Innen sowohl die wesentlichen Aspekte, wie eine nachhaltigen Quartiers-, Stadt- und Infrastrukturentwicklung an der behandelten Fallstudie umgesetzt wurde, verstanden haben und kritisch reflektieren können wie auch in angemessener Form präsentieren können.

Die Gesamtnote des Moduls setzt sich aus dem Essay (70%) sowie dem Kurzvortrag (30%) zusammen. Die Prüfungsleistung erfolgt Online: das Essay wird auf Moodle hoch geladen und die Präsentationen finden über ZOOM statt.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Die Inhalte der Module

BV620007 Grundlagen des nachhaltigen Bauens
BV000029 Verkehrstechnik und Verkehrsplanung Grundmodul
BV000031 Siedlungswasser- und Abfallwirtschaft Grundmodul

sollten den Student*Innen geläufig sein.

Inhalt:
In diesem Modul werden die Zusammenhänge zwischen stadtplanerischen und ingenieurwissenschaftlichen sowie architektonischen Konzepten und den hiermit in Verbindung stehenden Energie-, Stoff- und Verkehrsströmen aufgezeigt und vor allem deren Umsetzung genauer behandelt.

Einzelne Projekte im Bereich Hoch- und Tiefbau sowie Infrastruktursysteme und Siedlungsquartiere werden genauer betrachtet und analysiert. Die Umsetzung dieser Projekte unter Berücksichtigung des Standortes, der sozialen und gesellschaftlichen Aspekte sowie die Einbindung der energetischen und politischen Fragestellungen werden anhand von Fallstudien praxisnah untersucht. Der Neubau ebenso wie Vorhaben der Sanierung, Projekte im Bereich Plusenergiehaus, Null-Emissionsquartiere werden herangezogen.

Hierbei wird auf die Kriterien der Nachhaltigkeit exemplarisch in den Phasen Planung, Bau, Betrieb und Rückbau eingegangen, um in einer aktiven Auseinandersetzung zukünftig Gebäude, Strukturen, Systeme und Entwicklungen bewerten zu können.

Lernergebnisse:
Nach dem Besuch des Moduls sind die Student*Innen in der Lage:

- die Kriterien für Nachhaltigkeit anhand von beispielhaften Projekten anzuwenden sowie deren Beeinflussung und Wechselwirkungen bei den mitspielenden Parameter zu verstehen.
- nachhaltige Entwicklungen in Städten und Quartieren sowie von Tief- und Hochbauten unter räumlichen, strukturellen, materiellen, kulturellen und gesellschaftlichen Aspekten zu verstehen.
- die verschiedenen Subsysteme wie Infrastruktur, Gebäudebestand, Neubau, städtebauliche Rahmenbedingungen, Energieversorgung, Verkehr, Mobilität, Wasser, Müll, Nahrung, Bildung, soziale Struktur, Ressourcen/ Kreisläufe auf Quartiersebene, Mikroklima, Lebensqualität, Gesellschaftsstrukturen, Nutzungsstrukturen, Wirtschaftsstrukturen zu bewerten.
- Konzepte der aktiven und passiven Gebäudetechnik sowie intelligente Gebäudehüllen und Systeme der Gebäudesteuerung zu verstehen.
- Faktoren wie Komfort, Klima, Energieverbrauch, Endlichkeit der Ressourcen und CO2 Ausstoß und deren gegenseitige Beeinflussung zu verstehen.
- szenarische Analysen und Beispiele zu verstehen und diese auf andere Objekte mit eigenen Lösungsvorschlägen anzuwenden.

Lehr- und Lernmethoden:
Das Modul setzt sich aus einer Vorlesungsreihe sowie einem Seminar zusammen.

Ergänzend zu den Dozent*Innen sind externe Expert*Innen aus Wissenschaft und Praxis in die Vorlesungsreihe eingebunden. Die verschiedenen Akteur*Innen der Stadtentwicklung vermitteln den Student*Innen praxisnah Einblicke in die unterschiedlichen Subsysteme der Stadt und stehen für Diskussionen zur Verfügung.

Im Seminar werden die in der Vorlesung vermittelten Inhalte durch interaktive Formate wie Workshops, Diskussionen, studentische Präsentationen und Gruppenbetreuungen sowie eine mehrtägige Exkursion zur aktuellen Fallstudie weiter vertieft.

Die Teilnehmer*Innen des Moduls suchen sich zu Beginn des Semesters jeweils ein Thema/ Objekt aus den Lehrinhalten aus. Die möglichen Schwerpunkte beziehen sich auf die Fallstudie des aktuellen Semesters. Diese sind einem der übergeordneten Themenfeldern der Stadt wie beispielsweise Materialströme, Mobilität, Quartiere oder Gebäude zugeordnet.
Während des Semesters wird das gewählte Thema/Objekt von den Student*Innen intensiv untersucht, ggf. vor Ort besichtigt sowie vorgestellt. Die Erarbeitung findet in kleinen Gruppen von jeweils 2-3 Student*Innen statt.
Zusätzlich werden durch begleitende Workshops einzelne Inhalte und Methoden weiter vertieft. Die Zwischenpräsentationen, im Verlaufe der Erarbeitung des Essays, dienen der Übung.

Die Student*Innen gestalten aktiv die Exkursionskomponenten mit und erarbeiten hierzu teils eigenständige Konzepte und Strategien.

Gegen Ende des Semesters wird das Ergebnis als schriftliche Ausarbeitung (Essay mit 5-7 Seiten zzgl. Grafiken, Bilder, Anhänge etc.) abgegeben.
Anschließend wird es in Form eines Kurzvortrags vorgestellt und gemeinsam diskutiert. In der Regel stellen die Student*Innen jeweils die Arbeit einer anderen Gruppe vor

Medienform:
Folien, Skriptum (wird erarbeitet aus den jeweiligen Vorlesungsschwerpunkten des Semesters), Poster, Präsentationen.
Exkursionen und Besichtigung der in den Fallstudien besprochenen Objekte mit unterstützenden Gastvorträgen und Führungen vor Ort.

Literatur:
Bott, H., Grassl, G. C., & Anders, S. (2018). Nachhaltige Stadtplanung: lebendige Quartiere, Smart Cities, Resilienz
(2. Aufl., überarbeitet und aktualisiert). München: Detail.
Ekardt, F. (2016). Theorie der Nachhaltigkeit: Ethische, rechtliche, politische und transformative Zugänge - am
Beispiel von Klimawandel, Ressourcenknappheit und Welthandel (2. Aufl., vollständig überarbeitet und aktualisiert).
Baden-Baden: Nomos.
Friedman, T. L. (2009). Hot, flat, and crowded: Why we need a green revolution--and how it can renew America
(Release 2.0, updated and expanded ; 1st Picador ed.). New York: Picador/Farrar, Straus and Giroux.
Heck, H.-D., & Meadows, D. L. (1972). Dennis Meadows [u.a.] Die Grenzen des Wachstums (The limits to growth,
dt.).

McDonough, W., & Braungart, M. (2002). Cradle to cradle: Remaking the way we make things (First edition). New
York: North Point Press.
Meadows, D. H., Meadows, D. L., & Randers, J. (1992). [Hauptband] (6. Aufl.). Die neuen Grenzen des Wachstums:
die Lage der Menschheit: Bedrohung und Zukunftschancen / Donella H. Meadows: A. Stuttgart: Dt. Verl.-Anst.

Zusätzlich wird zu Semesterbeginn jeweils eine ergänzende fallstudienspezifische Literaturliste auf Moodle zur Verfügung gestellt.

Modulverantwortliche(r):
Prof. Dr.-Ing. Werner Lang sekretariat.enpb.bgu@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Fallstudien nachhaltiger Quartiers-, Stadt- und Infrastrukturentwicklungen (Seminar, 2 SWS)
Lang W [L], Hernández Chamorro A, Lang W, Schwering K, Theilig K

Nachhaltige Quartiers-, Stadt- und Infrastrukturentwicklungen (Vorlesung, 2 SWS)
Lang W [L], Hernández Chamorro A, Schwering K
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2716: Forest Growth and Forest Operations | Forest Growth and Forest Operations

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning success of the module Forest Growth and Forest Operations will be assessed by a written examination of 90 minutes. This is due to the fact that biometric topics, growth processes and analyses as well asthe forest growth modelling part of the lecture can be presented best in a written formby drawings, figures, calculation schemes, etc. For example the description of biological processes and growth cycles in forest growth simulators can best be explained and depicted by graphical representations.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in biology and forest science.

Inhalt:
The part Forest Growth deals with objectives and methods of forest growth and yield science. First, as fundamental topic, principal factors of the organic production of forest stands based on the driving forces (climate, water, nutrients) are shown and explained. In a next step growth and yield is analyzed more closely as part of the total production of plant communities. This leads to principles of tree shape development, tree growth and carbon dynamics in general. From individual tree growth the course proceeds to structure and development of whole forest stands. Both previous subjects provide the basic knowledge for understanding the effect of silvicultural treatment on quantitatively measured growth and yield characteristics. Growth trends, productivity and carbon dynamics of the main tree species in Central Europe are presented. Analyses of stand structure, growth and yield in the view of climate change are discussed. Different types of forest growth models on tree, stand and forest enterprise levels are introduced. The part Forest Operations can be divided in 5 topics: (1) Overview of mechanized harvesting (methods and

most common systems), (2) Environmentally sound resource road planning and construction, (3) Assessing the environmental impacts of forest operations on forest stands and soils, (4) Means of eco-efficient wood transportation from the forest to the mill and (5) Current developments in small-scale forest operations.

Lernergebnisse:
On successful completion of the module, students are able to
- Understand the environmental factors influencing the forest stand production
- Describe the effects of silvicultural treatment on quantitatively measured growth and yield characteristics
- Understand the principles of growth models
- Analyze and evaluate the impact of environmental changes on tree and stand growth
- Create possible silvicultural measures to mitigate negative effects of environmental changes on forest stand growth
- Understand and evaluate the impact of biotic and abiotic factors on growth, vitality and stability of individual trees and forest stands
- Understand the fundamentals of sound resource road planning and construction
- Describe the links between mechanized harvesting and potential stand and soil damages
- Evaluate the productivity and carbon footprint of different harvesting systems.

Lehr- und Lernmethoden:
Lectures and presentations, field trip (optional).

Medienform:
Lectures and presentations (pdfs).

Literatur:
FOREST GROWTH: Pretzsch, H., (2009): Forest Dynamics, Growth and Yield. Springer Verlag, Berlin, 664 S. 2009 published as Hardcover(ISBN 978-3-540-88306-7) 2010 published as paperback (ISBN 978-3-642-14861-3) FOREST OPERATIONS: Bowers, S. 2012. Designing woodland roads. Oregon State University. EC 1137. 21 pp. Dykstra, D. P. and Heinrich, R. 1996. FAO Model code of forest harvesting practice. 85 pp. Enters, D., Applegate, G.B., Kho, P. C.S., and Man, G. (Eds.) 2002. Applying reduced impact logging to advance sustainable forest management. FAO. Heinrich, R. Recent developments on environmentally friendly forest road construction and wood transportation in mountainous forests. Rummer, B. 2009. New technology in forest operations. www.forestlandowners.com. 3 pp. Sutherland, B.J. 2003. Preventing soil compaction and rutting in the boreal forest of western Canada. FERIC. 53 pp.

Modulverantwortliche(r):
Rötzer, Thomas; Apl. Prof. Dr. agr. habil.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Low Impact Forest Operations (Vorlesung, 1,5 SWS)

Bauer E, Engler B

Low Impact Forest Operations Technology (Exkursion, ,5 SWS)
Bauer E, Engler B

Forest Growth (Vorlesung, 2 SWS)
Pretzsch H, Rötzer T
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4098: Forestry Raw Materials and their Utilization | Forestry Raw Materials and their Utilization

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning success will be assessed by a written examination (duration 60 min) where students are expected to demonstrate the level of knowledge and their ability to use and apply it in solution finding strategies. Additionally a midterm Assignment, the students have to prepare and give a structured oral presentation in a seminar organized at the end of the summer term. The topic of the presentation is defined in agreement with the lecturer. The presentation may be prepared either individually or in groups of two. The midterm presentation Assignment allows to improve the examination mark by 0.3.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basics of biology, chemistry, physics and sciences to deal with the biological production, and the processing and conversion processes of wood to final products, and the environmental assessment.

Inhalt:
1. Overview and global potential of forest resources;
2. Availability, characteristics and properties of forest based products (wood and non-timber forest products);
3. Technologies and processes from raw materials to final products: sawn timber, wood-based products, pulp and paper;
4. Criteria and rules of a resource efficient application;
5. Environmental assessment of forestry raw materials and products.

Lernergebnisse:
Upon successful completion of the module students are able to:
- illustrate the multidisciplinary of forests and their products;
- propose options to maximize the value chains of forest based products;
- exemplify production and process technologies and typical sector industries;
- demonstrate the role, potential and limitations of forestry raw materials in the framework of sustainable development;
- outline economical, environmental and social aspects of typical products and applications;
- develop strategies to strengthen the value and impact of typical forestry raw materials and non-timber forest products.

Lehr- und Lernmethoden:
Lecture, exercises, seminar, Optional: visits to laboratories and industry.

Medienform:
Demonstration material: raw materials and products; PP presentations; videos.

Literatur:
Fengel, D.; Wegener, G. (2003): Wood - Chemistry, Ultrastructure, Reactions. Kessel Publishers
Dinwoodie, J.M. (2000): Timber: Its nature and behaviour. Van Nostrand Reinhold Publishers
Forest Products Laboratory (ed) (2010): Wood as an Engineering Material: http://www.fpl.fs.fed.us-documnts-FPLGTR-fplgtr.113-PL113.htm.
Rowell R. ed. (2012): Handbook of Wood Chemistry and Wood Composites. Sec. Edition, CRC Press Taylor & Francis Group, 703 pp.
Shmulsky, R., Jones P.D (2011): Forest Products & Wood Science, 6th ed. Wiley-Blackwell, Chichester UK

Modulverantwortliche(r):
Prof. Dr. Klaus Richter – Lehrstuhl für Holzwissenschaft Winzererstr. 45, 80797 München, Tel.: 089/ 2180 - 6421, richter@hfm.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Forestry Raw Materials and their Utilization (Vorlesung, 2 SWS)
Richter K, van de Kuilen J, Sanchez-Ferrer A

Forestry Raw Materials and their Utilization (Übung, 2 SWS)
Richter K, van de Kuilen J, Sanchez-Ferrer A
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4161: Forest Management | Forest Management

Modulbeschreibungsversion: Gültig ab Sommersemester 2022

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The module integrates different scientific and management methods with the objective to develop concepts for the sustainable management of forest. Forest managers must understand complex content and be able to explain it to a critical audience. The learning outcome will be assessed by an oral exam (30 minutes) covering the whole outcomes of the module.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None.

Inhalt:
1. Definition of forest and forest ecosystem
2. Overview of forestry on global, regional and local scales
3. Introduction into objectives and methods of forest ecosystem management and forest management planning
4. Demonstration of forest decision support systems and multiple-objective optimization
5. Overview of silvicultural techniques
6. Basic Knowledge of Forest economics
7. Demonstration of examples in lowland and mountain forest management.

Lernergebnisse:
At the end of the module the students are able to:

- understand different concepts of forest management
- understand different demands in forest management
- apply means of linear programming to harmonize different measures
- apply decision support systems
- evaluate different forest management measures.

Lehr- und Lernmethoden:
The module is separated into lectures and exercises. Lectures providing the theoretical foundations and concepts in Forest Management.
Exercises are done in supervised groups in the field.

Medienform:
PowerPoint presentations, additional reading material, software application.

Literatur:
FAO (2018): State of the World's Forests; FAO (2016): Global Forest Resources Assessment 2015.

Modulverantwortliche(r):
Felbermeier, Bernhard; Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Forest Ecosystem Management (Vorlesung, 2 SWS)
Felbermeier B [L], Annighöfer P, Felbermeier B

Forest Management Planning (Übung, 3,5 SWS)
Knoke T, Bödeker K, Döllerer M, Gang B, Kienlein S, Pintado K
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4189: Fisheries and Aquatic Conservation | Fisheries and Aquatic Conservation

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Current information regarding the limited activities with physical presence due to the CoViD19-pandemic:
In case the framework requirements (hygienie, distance rules etc.) for examinations with physical presence are not met, the planned examination format can be changed to a digital (remote) examination according to §13a APSO. The decision on this change will be communicated as soon as possible, however latest 14 days before the actual examination date, by the responsible examiner in coordination with the examinations board.

The examination consists of a 60 min. written exam (Klausur). In addition, the students need to prepare a 10-15 min. presentation in the practical exercise. Gradings from the examination and the presentation are weighed in the ratio 2:1. The examination means to measure the student’s ability to assess anthropogenic influence on aquatic ecosystem functioning, evaluate the socioeconomic importance of fisheries and aquaculture , explain factors affecting susceptibility to and recovery from overexpoitation and recall fisheries management tools for wild populations as well as of the underlying biological principles such as fish population dynamics. In the written examination students demonstrate by answering questions under time pressure and without helping material their theoretical and practical (e.g. application of methods) knowledge about fisheries management. For answering the questions, the students require their own wording.
In the practical excercise the students prepare a presentation in form of a broschure, poster, video or podcast. For the presentation, the student is expected to demonstrate that he or she is capable of preparing a certain topic within a given time frame in such a way as to present or report it in a clear and comprehensible manner to specific target audiences in the context of fisheries and aquatic conservation.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Interest in aquatic biology, social sciences, conservation biology and management; this course can be selected
independently from other courses in the fields of Fish Biology and Limnology at TUM

Inhalt:
The module combines the theoretical background and the practical implementation of fisheries management and aquatic conservation. The key aspects are:
1. Introduction to fish, shellfish and fisheries management,
2. The socioeconomic importance of fisheries and aquaculture,
3. The functioning of aquatic ecosystems and the impacts of fisheries on aquatic ecosystem health,
4.Factors affecting susceptibility to and recovery from overexploitation,
5. Fisheries Management Tools for wild populations,
6. Aquaculture,
7. Aquatic Biodiversity Conservation,
8. Case study and knowledge transfer/communication excercise

Lernergebnisse:
At the end of the module students understand the importance of aquatic resources for mankind and the variables which influence ecosystem functions as well as the principles of aquatic biodiversity conservation. They are able to analyze the effects of natural and man-made disturbances in aquatic ecosystems (e.g. overexploitation) based upon an interdisciplinary understanding of methodological aquatic
and fisheries biology, human dimensions, socioeconomic factors and management skills. In addition, students are able to objectively integrate knowledge from different disciplines (e.g. fish biology, conservation biology, commercial fishing techniques, aquatic habitat assessment and management) to evaluate sustainable resource management.

Lehr- und Lernmethoden:
The module combines a lecture "Fisheries Management" with an accompanying practical excercise " Applied Aquatic Conservation". The lecture contents will be presented using lectures based on power-point presentation, group work and interactive role plays in order to combine activating teaching methods with classic presentation techniques. In the accompanying practical excercise to the lecture the students will apply the gained theoretical knowledge by conducting case studies or participating research experiments with various content in the field of freshwater ecology and aquatic conservation. The content of the practical work is incorporated into running research projects at the chair (e.g. habitat restoration, artificial breeding programmes, habitat assessment, conservation genetics). Additionally, the students learn to independently screen the respective literature in this field and learn methods in science communication.

Medienform:
Form of presentation: lecture, case study, movie segment and practical excercise

material: lecture notes, flip-chart/board, plus different materials for methodological/technical training

Literatur:
1. King (2007) Fisheries Biology, Assessment and Management
2. Helfman (2007) Fish Conservation: A guide to understanding and restoring global aquatic biodiversity and fishery
resources
3. Moyle & Cech (2004) Fishes An introduction to Ichtyology
4. Primack (2008) A primer of conservation biology

Modulverantwortliche(r):
Geist, Jürgen; Prof. Dr. rer. nat.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Fisheries Management (Vorlesung, 2 SWS)
Geist J

Applied Aquatic Conservation (Übung, 2 SWS)
Geist J [L], Bayerl H, Geist J, Pander J, Stoeckle B, Zingraff-Hamed A
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

IN2124: Grundlegende Mathematische Methoden für Imaging und Visualisierung | Basic Mathematical Methods for Imaging and Visualization

Modulbeschreibungsversion: Gültig ab Wintersemester 2011/12

Modulniveau: Bachelor/Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Prüfungsart: schriftliche Klausur

Die Prüfungsleistung wird in Form einer 75-minütigen schriftlichen Klausur erbracht, in der die Studierenden anhand der gestellten Aufgaben nachweisen, dass sie über Kenntnisse der grundlegenden mathematischen Methoden verfügen, und diese erfolgreich bei der Lösung von einfachen, abstrakten mathematischen Problemstellungen anwenden können. Ferner demonstrieren die Studierenden beim Lösen von Aufgaben mit Bezug zu konkreten Anwendungen in Image Processing und Computer Vision, dass sie Anwendungsprobleme mathematisch formulieren können, ihre mathematischen Eigenschaften analysieren können, und mit geeigneten Methoden lösen können.

Wiederholungsmöglichkeit:
Semesterende

(Empfohlene) Voraussetzungen:
IN0015 Diskrete Strukturen, IN0018 Diskrete Wahrscheinlichkeitstheorie, IN0019 Numerisches Programmieren, MA0901 Lineare Algebra für Informatik, MA0902 Analysis für Informatik

Inhalt:
Grundlegende, oft angewandte Techniken werden in der Vorlesung präsentiert und anhand von Anwendungen aus Image Processing und Computer Vision demonstriert. Dieselben mathematischen Methoden kommen aber auch in anderen Ingenieurs-Disziplinen wie Künstliche Intelligenz, Machine Learning, Computergrafik, Robotik etc. zum Einsatz.

Folgende Inhalte werden beispielhaft behandelt:
- Lineare Algebra
++ Vektorräume und Basen
++ Lineare Abbildungen und Matrizen
++ Lineare Gleichungssysteme, Lösen von linearen Gleichungssystemen
++ Methode der kleinsten Quadrate
++ Eigenwertprobleme und Singulärwertzerlegung
- Analysis
++ Metrische Räume und Topologie
++ Konvergenz, Kompaktheit
++ Stetigkeit und Differenzierbarkeit im Mehrdimensionalen, Taylor-Entwicklung
- Optimierung
++ Existenz und Eindeutigkeit von Minimierern, Identifikation von Minimierern
++ Gradientenabstieg, Conjugate Gradient
++ Newton-Verfahren, Fixpunktiterationen
- Wahrscheinlichkeitstheorie
++ Wahrscheinlichkeitsräume, Zufallsvariablen
++ Erwartungswert und bedingte Erwartung
++ Schätzer, Expectation Maximization Methode

In den Übungen gibt es die Möglichkeit für die Teilnehmer bei der Implementation oder Anwendung der Methoden zur Lösung von realen Problemstellungen ein tieferes Verständnis zu erlangen und praktische Erfahrung zu sammeln.

Lernergebnisse:
Nach der erfolgreichen Teilnahme an diesem Modul verstehen die Teilnehmer die grundlegenden mathematischen Techniken und Methoden. Sie sind dann in der Lage, reale Aufgabenstellungen im Gebiet Imaging und Visualisierung zu formulieren sowie Methoden für die Problemlösung auszuwählen, zu optimieren und zu bewerten. Sie können diese Techniken und Methoden auch auf andere Ingenieurs-Disziplinen wie Künstliche Intelligenz, Machine Learning, Computergrafik, Robotik, etc. anwenden.

Lehr- und Lernmethoden:
Das Modul besteht aus einer Vorlesung und einer begleitenden Übungsveranstaltung. Die Inhalte der Vorlesung werden im Vortrag und durch Präsentation mit Tafelanschrieb vermittelt. Studierende werden insbesondere durch die Lösung von Übungsblättern zur inhaltlichen Auseinandersetzung mit den Themen und ihren Anwendungen angeregt. Die Lösung der Übungsaufgaben wird in der Übungsveranstaltung besprochen.

Medienform:
Folienpräsentation, Tafelanschrieb

Literatur:
MATLAB

- Cleve Moler, first chapter of Numerical Computing with MATLAB, SIAM Linear Algebra
- Yousef Saad, Iterative Methods for Sparse Linear Systems, SIAM
- Lloyd N. Trefethen and David Bau, Numerical Linear Algebra, SIAM
- Gilbert Strang, Introduction to Linear Algebra, Wellesley-Cambridge Press Analysis
- Walter Rudin, Real and Complex Analysis, McGraw-Hill Optimization
- Ake Björck, Numerical Methods for Least Squares Problems, SIAM
- Jonathan Shewchuk, An Introduction to the Conjugate Gradient Method Without the Agonizing Pain
- Uri Ascher, A first course in numerical methods, SIAM Probability Theory
- Heinz Bauer, Measure and Integration Theory, deGruyter
- Sheldon Ross, Introduction to probability and statistics for engineers and scientists, Elsevier PDEs
- Lloyd Nick Trefethen , Finite Difference and Spectral Methods for Ordinary and Partial Differential Equations
- Cleve Moler, chapter 11 of Numerical Computing with MATLAB, SIAM

Modulverantwortliche(r):
Navab, Nassir; Prof. Ph.D.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Grundlegende Mathematische Methoden für Imaging und Visualisierung (IN2124) (Vorlesung mit integrierten Übungen, 4 SWS)
Lasser T [L], Lasser T (Cheslerean-Boghiu T, Page Vizcaino J, Pekel E, Wollek A)
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2717: Genetic Resources Management and Forest Protection | Genetic Resources Management and Forest Protection

Modulbeschreibungsversion: Gültig ab Wintersemester 2020/21

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning outcome will be assessed by a written exam (duration 60 min) where the student have to analyze the risk of given pest and abiotic hazard-scenarios and to develop adequate disturbance management strategies. Furthermore, they have to analyze a genetic diversity study from a plant, animal or fungus species and develop a long-term genetic management strategy. In this way, the students can demonstrate that they have obtained the ability to use their knowledge in real world management situations.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in biology and forest science

Inhalt:
Part I Genetic Resources Management – Schaefer/Benz
1. Introduction: DNA, genetic code, genes, alleles, genomes, speciation
2. Basics of Population Genetics
3. Genetic variation in forest ecosystems
4. Tree breeding
5. Genetic conservation & sampling strategies
6. GRM in mountain ecosystems
7. GRM in the Tropics
8. GRM in the dry zones
9. Sustainable management strategies
10. Fungi – The Good, the Bad, and the Ugly
11. The genetic treasure trove of fungi

Part II Disturbance ecology & management– Seidl/Seibold
1. Disturbance ecology 101 (R. Seidl)
2. The role of disturbances in forest ecosystem dynamics (R. Seidl)
3. Forest protection strategies in the course of time (S. Seibold)
4. Wind (R. Seidl)
5. Snow and ice (R. Seidl)
6. Fire (R. Seidl)
7. Drought (R. Seidl)
8. Functional roles of insects in forest ecosystems (S. Seibold)
9. Bark beetles – ecology (S. Seibold)
10. Bark beetles – management and impacts (S. Seibold)
11. Defoliators (S. Seibold)
12. Aphids, adelgids and others (S. Seibold)
13. Deadwood-inhabiting insects (S. Seibold)
14. Principles of disturbance management (R. Seidl)

Lernergebnisse:
On successful completion of the module, students are able to
- assess genetic diversity patterns in natural populations of different groups of organisms (mammals, birds, plants, fungi)
- understand the importance of maximizing genetic diversity
- understand the impact of biotic and abiotic factors on vitality and stability of individual trees and forests;
- understand the impact of fungal pathogens and insects on trees;
- apply their ecological knowledge to minimize and forecast the risk of damages by fungal pathogens;
- U explain the most important abiotic and biotic causes of tree death in forest ecosystems
- ccharacterize forest disturbance regimes
- understand the different roles that disturbances play in forest ecosystems
- kexplain how plants adapt to different disturbance agents
- develop different disturbance management strategies.

Lehr- und Lernmethoden:
Lectures and presentations: provide the theoretical population genetics and ecological background to understand the role of genetic diversity in general and the role of disturbance at population level and beyond.
Group work: will be used to learn how to assess and interpret genetic diversity patterns in various real world examples and to practice risk forecasting in disturbance management or develop disturbance management strategies.
Field trip (optional): to help understand the role of disturbance and genetic diversity in a real Bavarian forest setting.

Medienform:
lectures and presentations (pdfs)

Literatur:
Frankham, et al. 2017, Genetic Management of Fragmented Animal and Plant Populations, Oxford University Press; Allendorf et al. 2013, Conservation and the Genetics of Populations, Wiley-Blackwell; Agrios, G.N. 2005, Plant Pathology, 5th edition. Elsevier Academic Press, Oxford; Speight, M.R. & Wylie, F.R., 2001: Insect pests in tropical forestry. CABI publishing; Ruppert, E.E. & Barnes, R.D., 1993: Invertebrate Zoology 6th edition (Chapter 16 insects; p 825-862)

Modulverantwortliche(r):
Schäfer, Hanno; Prof. Dr. rer. nat.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Genetic Resource Management (Vorlesung, 2 SWS)
Benz J, Schäfer H

Disturbance ecology and management (Vorlesung, 2 SWS)
Seidl R [L], Seidl R, Seibold S
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ1545: Human Resource Management in Agriculture and Related Industries | Human Resource Management in Agriculture and Related Industries

Modulbeschreibungsversion: Gültig ab Wintersemester 2018/19

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
During the written exam (90 min.) students demonstrate their ability to understand human resource management practices, to select and adapt techniques suitable to specific contexts in agriculture and life science industries, to compare and contrast techniques and practices, to evaluate and change selected practices in case applications. Example practices cover the fields of planning the workforce, recruiting, selecting, and training employees, as well as providing feedback to, and evaluating employees, as well as discipline and dismissal, compensation, incentive plans, benefits and services, and workplace diversity. Students analyze exam questions and write up answers in their own words.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
BS Degree. Prior knowledge of basic ideas of economics and management is required; knowledge in strategic management is recommended.

Inhalt:
The course is designed to provide master level students with an understanding of pertinent human resource management practices and how to adapt practices from other industries to farms, horticultural and landscaping operations, in agribusinesses, in the food industry, and in related businesses. Practices relate to planning the workforce, recruiting, selecting, and training employees, as well as providing feedback to, and evaluating employees. Additional practices relate to discipline and dismissal, compensation, incentive plans, benefits and services, and workplace

diversity. Examples of current issues as well as laws and regulations provide context for different human resource management practices.

Lernergebnisse:
After successfully completing the module, students are able to accomplish the following:
- understand human resource management practices and their objectives;
- evaluate human resource management practices in use;
- develop and adapt appropriate human resource management practices for specific organizations in agriculture and the life science industries.
- determine the fit of different human resource management practices with different organizational goals and environments.

Lehr- und Lernmethoden:
Lectures serve to introduce human resource management practices and their objectives.
Video clips serve to illuminate HRM practices and as a basis of discussion of practices. Case descriptions and task sheets are analyzed in small groups and discussed in class to empower students to apply human resource management practices in specific constellations.

Medienform:
Presentation software, case descriptions and task sheets, discussion facilitation support media, video clips

Literatur:
Dessler, G. (latest edition). Human resource management, Prentice Hall: Upper Saddle River/NJ.

Modulverantwortliche(r):
Bitsch, Vera; Prof. Dr. Dr. h.c.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Human Resource Management in Agriculture and Related Industries (Seminar, 4 SWS)
Bitsch V [L], Bitsch V, Huhn C, Wagner C
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2731: Hydrometeorology and Management of Water Resources | Hydrometeorology and Management of Water Resources

Modulbeschreibungsversion: Gültig ab Sommersemester 2022

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning outcome will be assessed by an oral examination (30 min) in which students should demonstrate their profound understanding of water management and ability to analyze and evaluate key issues and challenges. They should exhibit the capability of identifying and solving problems in a concise way and show that they can express themselves in a clear and scientific manner. A voluntary mid-term assignment (presentation) in the seminar assesses the students' ability to communicate and present an integrated management study case in one selected topic in sustainable water management. It will serve for grade improvement by 0.3 according to §6(5) APSO.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in chemistry and physics.

Inhalt:
1. Hydrometeorology (including hydrological cycles, precipitation-, run off-, evapotranspiration - process of formation, measurement, global and regional spatial and temporal patterns, influences by land use land cover change, climate change scientific basis, climate change impacts, adaptation, vulnerability in water resources).
2. Problems in water management according to too little water, too much or too dirty. Different aspects of water augmentation (e.g. harvesting, desalination, translocation), water conservation (irrigation, pricing, household, …), water management processes (e.g. IWRM, virtual water) are discussed by practical examples;

Lernergebnisse:
Upon the successful completion of this module the students are able to understand the basics of hydrology, and the influence of climate change on hydrological processes and management. They are able to analyze and classify various problems in water resource management and to assess the suitability and applicability of different management practices in the field of water augmentation (e.g. rain water harvesting, fog nets, dams) and water saving strategies (e.g. in irrigation, sanitation) to integratively solve water-resource-problems.

Lehr- und Lernmethoden:
The basics of hydrology and meteorology are presented and discussed in a lecture with thorough explanations. Some simple case studies are used to introduce into the theoretical background (e.g. meteorological instruments at the meteorological platform). Student presentations and discussions, group work in the seminar.

Medienform:
PowerPoint presentations; Presentation notes supporting the lecture. Case studies.

Literatur:
Ahrends (2000) Meteorology today, 7th edition. Jones JAA (2010) Water Sustainability - A Global Perspective, Hodder Education London. Clarke R & King J (2004) The atlas of water. Figueres C. et al. (2003) Rethinking water management. Wescoat JL et al. (2003) Water for life, water management and environmental policy. Grambow M (2008) Wassermanagement.

Modulverantwortliche(r):
Prof. Dr. Annette Menzel - Professur für Ökoklimatologie Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, 08161/ 71-4740, amenzel@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Management of Water Resources (Vorlesung, 2 SWS)
Estrella N, Menzel A

Introduction to Hydrometeorology (Vorlesung, 2 SWS)
Menzel A [L], Estrella N, Menzel A
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

EI7467: Interdisciplinary Project Internship Concept Development of a Renewable Energy System in a Developing Country | Interdisciplinary Project Internship Concept Development of a Renewable Energy System in a Developing Country

Modulbeschreibungsversion: Gültig ab Wintersemester 2016/17

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 135	**Präsenzstunden:** 45

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:

Inhalt:

Lernergebnisse:

Lehr- und Lernmethoden:

Medienform:

Literatur:

Modulverantwortliche(r):
Hamacher, Thomas; Prof. Dr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Interdisziplinäres Projektpraktikum Konzeptentwicklung eines Erneuerbaren Energiesystems in einem Entwicklungsland (Forschungspraktikum, 4 SWS)
Hamacher T, Bazan S, Cadavid Isaza A, Pant P
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

LS50000: International Climate Strategies / UNFCCC | International Climate Strategies / UNFCCC

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 90

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
For this module, students will give a presentation (ca. 30 min, 30% of final grade), contribute to a blog (10% of final grade) about the COP conference, and submit a written term paper (ca. 15 pages, 60% of final grade).
The purpose of the presentation is to display students' ability to conduct research independently and to present results in a professional manner, using PowerPoint or an equivalent presentation software. The blog about the COP conference will indicate students' evolving knowledge of and insights into ongoing discussions and relevant topics at the COP. In their term paper, students shall demonstrate their ability to conduct an in-depth analysis of a case study on respective climate strategies and politics and UNFCCC involvement as related to climate change adaptation, mitigation and sustainability challenges. Students have the opportunity to alternatively choose for a nation or group of actors or a thematic topic (such as climate finance or climate justice) for their written paper. They shall establish their analytical competence with regards to current problems and transdisciplinary connections between international climate politics and domestic circumstances, including available environmental resources.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:

Inhalt:
The module International Climate Strategies / UNFCCC comprises following topics:
- Climate politics as an integrative part of environmental policy
- Evolution of climate negotiations under the UNFCCC and related actors' strategies

- UNFCCC design and processes, also practically experienced as part of an NGO observer delegation to COP negotiations
- Dynamics of international climate negotiations in times of crisis
- Interactions between country delegations and NGO observer delegations
- Climate change mitigation, adaptation, finance and loss & damage
- Climate justice
- National climate change adaptation and mitigation policies and their relation to international climate policy
- National climate policies' embeddedness in and relations to natural environmental resources and resulting sustainability options, such as LULUCF

Lernergebnisse:
After participating in the module, students will be able
- to identify history, key concepts, actors, their strategies, and discourses in the UNFCCC process and related national climate policy debates and be exposed to negotiation theories and tactics
- to apply methods of comparative analysis to climate politics at the national and international levels and test theoretical concepts with empirical research/field study methods
- to have a deeper understanding of different aspects of climate change politics, such as mitigation, adaptation, finance, and loss & damage
- to apprehend the political challenges and opportunities embedded in big transformations, such as the one required to address the current climate crisis
- to identify climate change related national environmental and socioeconomic factors, such as geography, natural resources, impacts and mitigation options, and to develop and understand their relationship to climate strategies of (group of) actors

Lehr- und Lernmethoden:
The module is comprised of a seminar and an excursion (either in person or online) to a UN Climate Conference (COP). Students will participate in a TUM delegation as NGO observers and attend one of the two weeks of a COP conference. Students who are unable to physically attend the COP conference will be expected to follow the conference online as the conference proceedings are live-streamed.
Two excursions will be offered of one week length each to allow as many students as possible to actively participate, pending the number of eligible places. Note: Excursion costs (flight, accommodation, food) will not be covered by TUM. It is recommended to have international health insurance. Accident insurance is provided in accordance with section VII of the German Social Security Code (SGB VII).
The seminar is divided into two parts – a preparatory pre-excursion and a follow-up post-conference debriefing and analysis. In the preparatory part, the students read relevant introductory literature on the UNFCCC and international climate science and politics. Students will prepare short presentations based on the reading materials, which will serve as the foundation for discussions with the whole group (Guided Reading). In the post-conference period, students will obtain a deeper understanding of the module's topic through general discussion about what was learned regarding the climate negotiations and side events (as observed during the excursion or online) as well as independent/group work on concrete examples. Students will analyse, evaluate

and interlink national climate policies to the natural science of climate change and environmental sustainability as perceived in the different regions / nations or for actor groups. The students will prepare and hold related presentations and actively discuss the international context.

Medienform:
Seminar talks and discussions (both online over ZOOM and in presence), PowerPoint presentations, online blog on COP experiences, TUM Moodle, Earth Negotiations Bulleting (ENB) Newsletter

Literatur:
• Guri Bang, Arild Underdal, & Steinar Andresen, eds. The Domestic Politics of Global Climate Change: Key Actors in International Climate Cooperation (Cheltenham, UK 2015).
• Jon Hovi & Tora Skodvin, eds. Climate Governance and the Paris Agreement. Special Issue, Politics and Governance, Open Access Journal, Vol. 4, No. 3 (2016).
• Falkner, R. (2013) Handbook of Global Climate and Environment Policy, Chichester: John Wiley & Sons Inc.
• David Coen, Julia Kreienkamp & Tom Pegram (2020) Global Climate Governance, Cambridge: Cambidge University Press.
• National Communications under the United Nations Framework Convention on Climate Change.
• Repository of UN Documents

Modulverantwortliche(r):
Menzel, Annette; Prof. Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
UNFCCC / COP Conference (Exkursion, 3 SWS)
Menzel A [L], Koppenborg F

International and National Dimensions of Climate Strategies in the Context of UNFCCC (Seminar, 3 SWS)
Menzel A [L], Koppenborg F, Menzel A, Schreurs M
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2733: Introduction to Soil Science | Introduction to Soil Science

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 80	**Präsenzstunden:** 70

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
In a written exam of 60 minutes duration, the students demonstrate by answering questions without helping material their understanding of the nature and properties of soils, and they remember the characteristics of the soils of the field course as well the field assessment methods. In a pass/fail exam (laboratory assignment) in the field of 10 minutes duration, they prove their ability to survey and interpret a soil profile.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in chemistry, physics, and biology.

Inhalt:
• What is a soil?
• Mineral (inorganic) soil components
• Soil biology and soil organic matter
• Soil chemistry
• Soil physics
• Soil-forming processes
• Soil survey
• Soil interpretation
• Soil erosion assessment

Lernergebnisse:
The students understand the basics of soil science. They can use their knowledge from soil mineralogy, soil organic matter, soil chemistry, and soil physics to understand soil formation

processes and important biochemical and physical properties. The students are able to survey a soil profile and to detect the genesis of the surveyed soil. They can evaluate the possibilities of soil use, the risks to the soil itself and the risks to its environment. They are able to evaluate the hydrology of the soil and to judge the erosion risk.

Lehr- und Lernmethoden:
The lecture discusses the essentials of soil science. The field assessment starts with peer instructions to analyse a soil profile. During the course, the students will do more and more group work to train the evaluation of a soil profile, its hydrology and its erosion risks.

Medienform:
Lecture: presentation notes. Field Assessment: spade, auger, knife, colour charts, TDR probes, suction cups, erosion assessment kits

Literatur:
Brady, Weil: The nature and properties of soils, 14th edition, 2007.
Blume et al.: Scheffer/SchachtschabelSoilscience, 2016.
Eash, Sauer, O'Dell, Odoi, Bratz: Soil science simplified, 6th edition, 2016.
Blum, Schad, Nortcliff: Essentials of Soil Science, 2016.
FAO Guidelines for Soil Description. Prepared by Jahn, Blume, Asio, Spaargaren, Schad, 2006.

Modulverantwortliche(r):
Schad, Peter; Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Introduction to Soil Science: Lecture (Vorlesung, 2 SWS)
Schweizer S

Introduction to soil science: Field course (Übung, 3,5 SWS)
Wiesmeier M [L], Wiesmeier M, Garcia Franco N, Völkel J, Putzhammer S, Schad P
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2725: Land-Use Systems from Local and Global Perspectives | Land-Use Systems from Local and Global Perspectives

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning outcome will be assessed by an oral exam (duration: 30 minutes).
In this form of exam the students can show how they are able to explain the farming systems and describe the elements and farming methods. Due to a deeper discussion the examiner is able to evaluate the students under-standing of farm practices, system concepts and interactions with site conditions.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
Basic information on farming: crops, crop rotations, permanent crops: hops and orchards; soil management, weed management; implements and machinery; organic and mineral fertilizers; pesticide use; livestock: animal husbandry, breeding criteria; consumer expectations; exemplified by Bavarian and German cases.
Introduction to farming systems worldwide: pastoral systems, permanent crops plantation systems, mixed systems, arable systems, intensive animal keeping; horticultural systems; students experience with agricultural land use in their countries.

Lernergebnisse:
On successful completion of the module students are able to remember and identify different crops, farm animals, machines and implements. They will be able to describe farming systems esp. the difference of organic and conventional systems. They will understand farm management methods and interactions inside farming systems. The students can classify land-use systems

worldwide and are able to explain the main elements and to evaluate the sustainability and resource impact.

Lehr- und Lernmethoden:
Lectures providing theoretical foundations. Examples will be given during the lectures.
Short field trips to farms and university research station, demonstrating crops, animals, technical equipment.
Short discussion sessions.

Medienform:
Power Point.

Literatur:
Tba

Modulverantwortliche(r):
Dr. Hans-Jürgen Reents; Dipl. Ing. Max Kainz - Lehrstuhl für Ökologischen Landbau und Pflanzenbausysteme Liesel Beckmann Str. 2, 85354 Freising, 08161/71 - 3778, reents@wzw.tum.de, kainz@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4094: Landscape Management - Application Study | Landscape Management - Application Study

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 95	**Präsenzstunden:** 75

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The assessment is based on: 1. the participation intensity on discussions and the quality of the contributions during the courses; 2. the demonstrated skills in creating new data layers by combining existing data from official sources (administrations, organizations, etc.) using GIS techniques, in exploring new data and information layers (RS, vegetation ecology), etc. 3. the contribution in developing the project (planning competences); 4. the presentation style, contents and layout; 5. the team work; 6. the project report.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
The successful completion of the modules "Inventory Methods and GIS", "Remote Sensing and Image Processing", "Geographical Information Systems and Vegetation Ecology" and "Landscape Planning" or equivalent skills are required, courses on scientific writing and reporting recommended.

Inhalt:
1. Implementation of GIS and RS techniques.
2. Implementation of theoretical concepts of Vegetation Ecology;
3. Implementation of theoretical concepts of Landscape Planning;
4. Oral presentation of findings;
5. Elaboration of a final report.

Lernergebnisse:
At the end of the module the students are able to develop or at least to contribute to a landscape management project. More in detail the students are able to:

- work in a team;
- apply the theoretical and practical skills in vegetation ecology, landscape planning, remote sensing and GIS techniques;
- contribute to context-dependant landscape-related planning;
- deliver an oral presentation to communicate their findings;
- prepare a convincing project report using supporting data to back their statements in accordance with guidelines for scientific writing.

Lehr- und Lernmethoden:
Prime characteristic of the Application Study is the self-organized group work by the students to reach the defined objective of the project assignment. Progress of the team is supported by group discussions, theory input and coaching provided by lecturers on demand.

Medienform:
Scripts and reports of the above listed lectures and exercises offered within the elective field; basic data sets to develop the application study (GIS, RS, etc.); additional information on request and up on necessity (project driven).

Literatur:
The literature recommended within the Modules "Inventory Methods and GIS", "Remote Sensing and Image Processing", "Geographical Information Systems and Vegetation Ecology", "Landscape Planning and Applied Development Cooperation" should be used.

Modulverantwortliche(r):
Dr. Thomas Schneider – Professur für Waldinventur und nachhaltige Nutzung Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, 08161/ 71-4666; tomi.schneider@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Landscape Management - Application Study (Vorlesung mit integrierten Übungen, 5 SWS)
Augenstein I, Döllerer M, Schneider T, Teixeira Pinto L
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2722: Mountain Catchments under Changing Climate | Mountain Catchments under Changing Climate

Modulbeschreibungsversion: Gültig ab Sommersemester 2020

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 80	**Präsenzstunden:** 70

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
In a written exam, students demonstrate that they have gained an understanding of hydrological processes and that they are able to apply and run a hydrological model for a mountain catchment. By an 10min oral presentation and a 5min discussion the students' ability to understand selected hydrology-related threats for mountain catchments and to scientifically analyze and evaluate important influencing factors, to present it to an audience, and to conduct a discussion about the presented subject in a clear and concise scientific manner is assessed. The final grade is an averaged grade from the presentation (65%) and the written exam (35%).

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Introduction in Hydrometeorology and management of water resources.

Inhalt:
In the Field Course Applied Hydrometeorology of Mountain Catchments we will visit selected research stations, field sites, hydrological infrastructure, restoration sites, and protected areas in the Munich PreAlpine and Alpine area and learn more about hydrology-related threats for mountain catchments ranging from Glacier melt to Munich's drinking water. Sites include e.g. Environmental Research Station Schneefernerhaus, KIT Alpine Campus Garmisch, Waldklimastation Kreuth, Sachenbach catchment, Versuchstation Obernach, Sylvensteinspeicher, Walchenseekraftwerk, Versuchsstation Wielenbach, Mangfall / Lech Wassereinzugsgebiet.
The Hydrological Modeling course includes:
1) Dominant hydrological processes in mountain catchments: Precipitation types, runoff generation, concentration and flood routing
2) Data in mountain catchments: Availability, quality, acquisition and analysis

3) Types of hydrological models
4) Generation, parameterization and calibration of the process based hydrological model WaSiM
5) Model sensitivity analyses with focus on meteorological input and land use scenarios.

Lernergebnisse:
After completion of the module, the students understand the main processes in mountain catchments like runoff generation, runoff concentration and flood routing processes. Additionally, they are able to use a physically based hydrological model to simulate the rainfall runoff process in mountain catchments and its influencing parameters caused by the special circumstances of these regions in a widely realistic and transparent way. The students are able to generate event based scenarios as well as land use scenarios and understand recent hydrology-related threats for mountain catchments as well as the influence of climate change on hydrological processes and management in mountain areas. They remember suitable monitoring and risk prevention strategies and are able to analyze, evaluate and communicate (both oral and written) a specific case study or research questions related to the experimental sites visited to a general audience.

Lehr- und Lernmethoden:
Teaching methods include lecture as well as practical exercises at PC laboratory in respect to hydrological modelling, a week of field trip to Alpine and pre-alpine areas to the listed sites with guided tours by local scientists, administrators, TUM lectures as well as short presentations by the students.

Medienform:
PowerPoint Presentation, Hydrological model (e.g. WaSiM), Field work

Literatur:
IPCC (2013) Fifth Assessment Report; Shelton ML (2009): Hydroclimatology - Perspectives and Applications; IPCC (2008) Technical Paper VI on Climate Change and Water

Modulverantwortliche(r):
Responsible for Module: Prof. Dr. Annette Menzel - Professur für Ökoklimatologie Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, 08161/ 71-4740, menzel@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Introduction in Hydrological Modelling (Vorlesung, 2 SWS)
Chiogna G

Field Course in Applied Hydrometeorology (Vorlesung mit integrierten Übungen, 3 SWS)
Menzel A [L], Lüpke M, Menzel A
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4206: Material Flow Management and Applications | Material Flow Management and Applications

Modulbeschreibungsversion: Gültig ab Wintersemester 2018/19

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 105	**Präsenzstunden:** 45

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The examination consists of a research paper of around 12-15 pages which is the means to evaluate whether the students have understood and whether they are able to apply the methodology of material flow management on a case study in a scientifically manner and to create an own scientific paper about concepts for material flow management and treatment of materials based on the methodologies of material flow analysis and life cycle assessment.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
knowledge in natural science (biology, chemistry, ecology, physics);
understanding for engineering science and also for social/cultural aspects.

Inhalt:
The students acquire detailed and differentiated knowledge about the following topics:
- need of material flow management
- procedure of material flow management
- material and substance flow analysis
- material flow assessment by sustainability indicators
- life cycle assessment
- development of strategies and measures for material flow management
(e.g. resource efficiency, urban mining, industrial ecology, bio-economy, circular economy).

Lernergebnisse:
By the means of the module the students are able to:
- understand the necessity of material flow management

- understand the relationships between different processes, technological treatments of materials and organizational measures
- apply the procedure of material and substance flow analysis
- apply the assessment methods of indicator systems and life cycle assessment
- create concepts for material flow management and treatment of materials.

Lehr- und Lernmethoden:
Concerning teaching methods, lecture and presentation parts provide the theoretical foundation of materials flow management. Real case studies are introduced to the students and worked out in the class. Likewise within interdisciplinary projects in reality, the students have to define and to solve problems collaboratively in group work by studying specialist literature and data sources. At the end they have to create a research paper as homework about this topic. The students are supervised by tutorials by the lecturer.

Medienform:
Power point presentation, lecture sheets, case studies of material and substance flow analysis and life cycle assessment.

Literatur:
Brunner, P.H., Rechberger H. (2004): Practical Handbook in Material Flow Analysis. Advanced Methods in Resource and Waste Management. Lewis Publishers, Boca Raton, pp. 318.
Brunner, P.H.; Rechberger, H.; 2016: Handbook of Material Flow Analysis: For Environmental, Resource, and Waste Engineers. Taylor & Francis Inc; 2. Revised Edition, pp. 453
Weber-Blaschke, G.; 2009: Stoffstrommanagement als Instrument nachhaltiger Bewirtschaftung natürlicher und technischer Systeme. Ein kritischer Vergleich ausgewählter Beispiele. Schriftenreihe „Nachwachsende Rohstoffe in Forschung und Praxis“ des Wissenschaftszentrums Straubing, Bd. 1, Verlag Attenkofer, Straubing, 330 S.

Modulverantwortliche(r):
Prof. Dr. Gabriele Weber-Blaschke - Lehrstuhl für Holzwissenschaft Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising; 08161/71- 5635; weber-blaschke@hfm.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Material Flow Management and Application (Vorlesung, 3 SWS)
Weber-Blaschke G [L], Weber-Blaschke G
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

BGU38023: Natürliche Aufbereitungsverfahren | Engineered Natural Treatment Systems

Modulbeschreibungsversion: Gültig ab Wintersemester 2016/17

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 3	**Gesamtstunden:** 90	**Eigenstudiums-stunden:** 60	**Präsenzstunden:** 30

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Die Prüfungsleistung wird im Rahmen einer 60 minütigen Klausur erbracht. Ziel der schriftlichen Prüfung ist der Nachweis, dass die Grundlagen und Mechanismen verschiedener natürlicher Aufbereitungsverfahren verstanden wurden und einfache Anlagen anhand bestehender Regelungen geplant und ausgelegt werden können. Die Antworten erfordern überwiegend eigene Formulierungen, wobei auch Fragen zum Ankreuzen von vorgegebenen Einfach- oder Mehrfachantworten und Rechenaufgaben gestellt werden. Neben einem nicht programmierbaren Taschenrechner sind keine weiteren Hilfsmittel zugelassen. Notwendige Unterlagen werden während der Klausur zur Verfügung gestellt.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Water and Wastewater Treatment Engineering

Inhalt:
In diesem Modul sollen Prozesse und Anwendungen natürlicher Aufbereitungsverfahren vermittelt werden. Wesentliche abiotische Eliminationsprozesse und mikrobielle Umsetzungsprozesse in natürlichen Verfahren werden zunächst allgemein diskutiert und anschließend bezogen auf die konkreten Anwendungen von Horizontal- und Vertikalfiltern in Pflanzenkläranlagen, der Uferfiltration und verschiedene Anwendungen der Grundwasseranreicherung besprochen.
Das Modul umfasst zusätzlich ingenieurtechnische Aspekte der Planung und des Betriebs von natürlichen Aufbereitungsverfahren sowie Inhalte aus der aktuellen Forschung zur Optimierung natürlicher Aufbereitungsverfahren und zu deren Kombination mit anderen Verfahren im Rahmen einer Wasserwiederverwendung.

Lernergebnisse:
Nach erfolgreicher Teilnahme an der Modulveranstaltung sind die Studierenden in der Lage:
• Die wesentlichen Mechanismen und Einflussgrößen zur Entfernung von Wasserinhaltsstoffen in natürlichen Verfahren zu beschreiben
• Mikrobielle Prozesse und deren Dynamik in natürlichen Aufbereitungsverfahren zu erklären
• Basierend auf vorhandenen Auslegungsgrößen ein Design für eine dezentrale Pflanzenkläranlage auszuwählen
• Die wesentlichen Methoden und Einsatzbereiche der Uferfiltration und der künstlichen Grundwasseranreicherung zu charakterisieren und deren Potential zur Gestaltung einer zukünftigen Wasserwirtschaft zu diskutieren

Lehr- und Lernmethoden:
Die Modulveranstaltung wird in Form eines Seminars angeboten, in dem die Inhalte in Form einer Vorlesung mit Diskussion vermittelt werden. Darüber hinaus werden gezielt Inhalte von den Studierenden in Gruppenarbeit erarbeitet. Zusätzliche Exkursionen dienen der Vertiefung und Diskussion der gelernten Inhalte.

Medienform:
Präsentationen, Gruppenarbeit

Literatur:
Wird in der Veranstaltung bekannt gegeben.

Modulverantwortliche(r):
Hübner, Uwe (u.huebner@tum.de)

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Natürliche Aufbereitungsverfahren (Seminar, 2 SWS)
Hübner U [L], Hübner U
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WI001215: Network and stakeholder analysis: Sustainable resource use and agri-food system | Network and stakeholder analysis: Sustainable resource use and agri-food system

Modulbeschreibungsversion: Gültig ab Wintersemester 2019/20

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
There will be a 120-minute written exam. A written exam is necessary in order to assess the holistic understanding and analytical competencies of the students. In the exam, students will describe, discuss and analyze the concepts, dimensions and methodological approaches related to network and stakeholders in sustainable resource management and agri-food sector.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in cooperation and sustainability

Inhalt:
The module deals with the theoretical concepts, methodologies and measurement indicators and approaches of networks and stakeholders for sustainable resource management and agri-food system. Specific topics include the following:

• Network and stakeholder theories and concepts to understand, describe and explain the structure, characteristics, interactions among networks and stakeholders

• Concepts and approaches to examine network and stakeholder compositions, engagements, conflicts and influences in designing and implementing strategic decisions related to sustainable innovation, resource management and agri-food system.

• Types, levels and extents of risk associated with stakeholder engagement in implementing sustainability related projects and programs

• Specific methodological approaches, tools and indicators to evaluate and prioritize the performances, outcomes and implications of different network and stakeholder constellations.

• Other relevant current network and stakeholder issues in sustainable innovation, resource management and agri-food system.

Lernergebnisse:
After completing the module, students are able to
• understand the theories, concepts, principles and frameworks underlying network and stakeholder issues, influences and collaborations for sustainable innovation, resource management and agri-food system
• apply relevant techniques and tools for describing social, economic, environmental and institutional contexts of network and stakeholder management and engagement policies and strategies towards achieving specific sustainable goals.
• analyze types, levels and extent of risks associated with stakeholder engagement and commitment in implementing sustainability related projects and programs

• critically assess and evaluate the structure, characteristics, and impacts of various forms of networks and stakeholder groups on the outcomes of sustainable resource management, innovation and agri-food system.

Lehr- und Lernmethoden:
The module includes lectures, individual and group exercises, reading assignments, and presentations. The lectures will provide theoretical and conceptual basis. Individual and team exercises will be used to analyze and discuss specific network and stakeholder issues and their solutions.

Medienform:
Präsentationen, Fallbeschreibungen, Skripte

Literatur:
Freeman, R.E (1984). Strategic Management: A stakeholder Approach. Boston.
Prell, C., K. Hubacek and M. Reed (2009). Stakeholder analysis and social network analysis in natural resource management. Society & Natural Resources 22(6): 501-518.
Chiffoleau, et al. (2014) Understanding local agri-food systems through advice network analysis. Agric Hum Values, 31:19–32
Lange, P. et al. (2015). Sustainability in Land Management: An Analysis of Stakeholder Perceptions in Rural Northern Germany. Sustainability, (7): 683-704.

Reed, M. S. et al. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management.Journal of Environmental Management 90(5): 1933-1949.
Mcadam, et al. (2016). Regional Horizontal Networks within the SME Agri-Food Sector: An Innovation and Social
Network Perspective. Regional Studies, 50(8): 1316–1329
Katz, N. et al. 2004. Network Theory and Small Groups. Small Group Research, 35(3): 307-332.
Sandström, A. and C. Rova (2010). Adaptive co-management networks: A comparative analysis of two fishery conservation areas in Sweden. Ecology and Society 15(3): 14.
Bixler, et al. R (2016). Network governance for large-scale natural resource conservation and the challenge of capture. Frontiers in Ecology and the Environment 14(3): 165-171.
Bixler, R. P. et al.(2016). Networks and landscapes: A framework for setting goals and evaluating performance at the large landscape scale. Frontiers in Ecology and the Environment, 14(3): 145-153.
Ernstson, et al. (2010). "Scale-crossing brokers and network governance of urban ecosystem services: The case of stockholm." Ecology and Society, 15(4): 28.
Muñoz-Erickson, T. A. and B. B. Cutts (2016). Structural dimensions of knowledge-action networks for sustainability. Current Opinion in Environmental Sustainability, 18: 56-64.
Wubben, E. and Gohar Isakhanyan. (2011). Stakeholder Analysis of Agroparks. Int. J. Food System Dynamics 2(2), 2011, 145#154.
The list will be expanded and updated using other thematically relevant books, journal articles and periodical newsletters and others.

Modulverantwortliche(r):
Abate Kassa, Getachew; Dr. rer. hort.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Network and stakeholder analysis: Sustainable resource use and agri-food system (Vorlesung, 4 SWS)
Abate Kassa G
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2719: Landscape Planning | Landscape Planning

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The attainment of learning outcomes for the module will be assessed in a piece of research paper of around 10 pages in which students work independently on complex issues of contemporary landscape planning demonstrating their breadth of understanding in drawing out implications of their findings and putting them into a broader context. The written assignment is complemented by a presentation and/or a colloquium of around 30 min for assessing the capacity of the students to communicate their findings orally to an audience. Depending on the number of participants, research paper and accompanying talk may be prepared either individually or in groups.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic understanding of environmental systems; Module WZ2713 Methods of Scientific Communication. For the LP seminar, class discussion is a core element. Therefore, students are expected to take part and contribute to the discourse.

Inhalt:
Concerned with the stewardship and enhancement of environmental systems, Landscape Planning is the key planning instrument for nature conservation and landscape management in Germany. The module introduces Landscape Planning and reflects on its potential contribution to sustainable land use with a focus on non-urban areas.
Course 1: Lectures will address the guiding principles, formal instruments and procedural elements of Landscape Planning; present methodological approaches for the assessment of landscape functions and ecosystem services including methods and tools for data collection, analysis and evaluation; illustrate target formulation and implementation strategies with examples from the planning practice.

Course 2: The seminar gives students the opportunity to deepen their knowledge by reflecting on readings and planning documents as well as by discussing in class such topics as: contemporary and emerging scientific theories and methodological approaches relevant for environmental planning; rationale of stakeholder involvement; context-dependency of spatial planning; comparison of current jurisdictional and institutional arrangements on landscape-related planning in the home countries of the students and their implications.

Lernergebnisse:
Upon completion of the module, students are able to:
- recognize the purpose and objectives of Landscape Planning;
- explain instruments and procedural elements of contemporary Landscape Planning;
- select appropriate methods and tools to assess landscape functions and ecosystem services;
- be aware of the role of Landscape Planning in the decision-making upon the use of land;
- retrieve and interpret information from different sources;
- communicate key concepts relevant for environmental planning (both written and oral).

Lehr- und Lernmethoden:
Lectures provide subject specific knowledge; class discussions of selected readings engage students in critical thinking; in group work activities students experience the application of selected methods and tools.

Medienform:
Lectures, presentations, class discussions, small group exercises, assigned readings.

Literatur:
Haaren, C. v., Lovett, A. & C. Albert (2019): Landscape Planning with Ecosystem Services – Theories and Methods for Application in Europe. Springer Nature, Dordrecht. Additional material will be provided.

Modulverantwortliche(r):
Dr. Isabel Augenstein i.augenstein@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Landscape Planning - lecture (Vorlesung, 2 SWS)
Augenstein I

Landscape Planning - seminar (Seminar, 2 SWS)
Augenstein I
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

EI74831: Project Lab Renewable and Sustainable Energy Systems | Project Lab Renewable and Sustainable Energy Systems [PropENS]

Modulbeschreibungsversion: Gültig ab Wintersemester 2018/19

Modulniveau: Master	**Sprache:** Deutsch/Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Teilnehmer am Projektpraktikum Erneuerbare und Nachhaltige Energiesysteme sollen Analysen, Planungen und Anwendungen rund um erneuerbare Energiesysteme und deren Modellierung durchführen.
Ein Team aus 3-5 Studierenden soll im Rahmen der Projektarbeit ein für die Gruppe definiertes Ziel über die Dauer der Vorlesungszeit des Semesters erreichen. Die Problemdefinition, Rollenverteilung, Ideenentwicklung sowie Wahl geeigneter Instrumente, Durchführung und Dokumentation sollen dabei von der Gruppe im Wesentlichen selbstständig erarbeitet werden.
Die wesentlichen Aspekte der Arbeit im Rahmen des Projektpraktikums (u.a. wesentliche wissenschaftliche Inhalte, die Behandlung einer Aufgabe als abgeschlossenes Projekt, Aufteilung der Aufgabe auf die Gruppenmitglieder) sollen in einem schriftlichen Bericht (Umfang: 15-20 Seiten) dokumentiert werden. In einer ergänzenden Präsentation soll die Kompetenz der Studierenden, ihre Arbeit strukturiert im Rahmen eines kleinen Seminars vor einem Publikum bestehend aus Mitarbeitern des Lehrstuhls und Studierenden vorstellen zu können, überprüft werden. Insgesamt sollen Kompetenzen in der Projektarbeit im Team sowie der Dokumentation und Darstellung der Arbeit nachgewiesen werden. Der Bericht geht mit 40 % in die Note ein, die Präsentation und die Mitarbeit im Team jeweils mit 30 %.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Grundkenntnisse über:
- Energiesysteme
- Erneuerbare Energien (Potenziale, Technik)
- Matlab / Simulink

Inhalt:
Es handelt sich um forschungs- und praxisnahe Aufgaben, deren Themen sich mit den aktuellen Forschungsbereichen des Lehrstuhls decken, wie:
- Modellierung, Simulation und/oder Regelung von Energiesystemen
- Potenzialuntersuchung von erneuerbaren Energien
- Analyse und Generierung von Daten für Energiesysteme
- Auswertung und Interpretation von Modellergebnissen
- Planung und Aufbau von Anlagen zur Nutzung von erneuerbaren Energien auf dem Campus Garching

Lernergebnisse:
Nach dem erfolgreichen Abschluss des Moduls ist der Studierende - je nach Themenbereich - in der Lage:
- Herausforderungen der Integration erneuerbarer Energien zu erkennen,
- geeignete Instrumente und Methoden zur Analyse, Planung oder Regelung von Energiesystemen anzuwenden und umzusetzen,
- Ergebnisse aus angewendeten Modellen zu interpretieren und bewerten.

Lehr- und Lernmethoden:
Projektaufgaben werden einzeln oder vorzugsweise in Gruppen von 2-4 Studenten durchgeführt. Dabei wird Selbsttändigkeit bzw. Teamfähigkeit in der Bearbeitung einer Projektaufgabe gefördert. Je nach Themenstellung kann eine Literaturrecherche von Nöten sein. Hauptteil des Projektpraktikums ist jedoch die rechnergestützte Entwicklung von Analyse- und Auswertungstools bzw. die Planung und Ausführung von labortechnischen Versuchen oder Installationen.
Die Teilnehmer haben zum Schluss die Gelegenheit, das Vorbereiten und Durchführen von Präsentationen zu üben.

Medienform:
- Anwendung verschiedener Programme bzw. Programmiersprachen (Matlab/Simulink, Python, o.ä.)
- Prüfstände (Anlagen zur Umwandlung erneuerbarer Energien, Echtzeit-Simulator, Messgeräte)
- Präsentationen

Literatur:
Konstantin, Panos: Praxisbuch Energiewirtschaft - Energieumwandlung, -transport und -beschaffung, Übertragungsnetzausbau und Kernenergieausstieg, Springer Vieweg, Springer-Verlag GmbH Deutschland, eBook ISBN 978-3-662-49823-1, DOI 10.1007/978-3-662-49823-1, Hardcover ISBN 978-3-662-49822-4

Wagner, Ulrich; Heilek, Christian (Bearb.): Nutzung regenerativer Energien (Vorlesungsskript), 10., vollständig überarbeitete Auflage, Herrsching, E & M, Energie-&-Management-Verl.-Ges., 2009, ISBN: 978-3-9805179-3-5

The Power of Transformation - Wind, Sun and the Economics of Flexible Power Systems, International Energy Agency, OECD/IEA, 2014, France, ISBN: 978 92 64 20803 2

Hillier, Frederick S., Lieberman, Gerald J.: Introduction to operations research, New York, McGraw-Hill Education, 2015, ISBN: 978-0-07-352345-3, 0-07-352345-3, 978-0-07-126767-0, 978-1-259-25318-8, 1-259-25318-X

Modulverantwortliche(r):
Hamacher, Thomas; Prof. Dr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Projektpraktikum Erneuerbare und Nachhaltige Energiesysteme (Forschungspraktikum, 4 SWS)
Hamacher T, Kuhn P, Breuning L, Cadavid Isaza A, de la Rua Lope C, Halilovic S, Kerekes A, Kleeberger H
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WI001205: People in Organizations: Managing Change and Sustainability in Agribusiness and the Food Industry | People in Organizations: Managing Change and Sustainability in Agribusiness and the Food Industry

Modulbeschreibungsversion: Gültig ab Wintersemester 2018/19

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The assessment type for the module is a graded report (100%). The report includes memorandums addressing 9-10 of the case studies discussed in class; and a concept paper addressing an organizational concept. The concept paper is also presented by each student. Through the case memorandums, the students demonstrate the ability to discuss the assigned case questions by selecting and applying suitable theoretical concepts to agribusiness and the food industry. Building on the reflection process for each individual memorandum and the cases, which build on each other, deep-level contextual learning is achieved. In the concept paper, students demonstrate their ability to research and critically evaluate a current organizational concept. Through the presentation and discussion of the concept paper, students demonstrate their ability to communicate theoretical concepts and their application to agribusiness and the food industry.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
This is an advanced module. Prior knowledge of economic and management concepts is required. Successful completion of a management course on MSc. level is required, e.g., Human Resource Management in Agriculture and Related Industries or Agribusiness Management. Experience in desk research and scientific writing is required. Knowledge of basic concepts of human resource management and management skills is required.

Inhalt:
The module builds on key concepts of economics and management, specifically human resource management, to provide master level students with knowledge in organizational behavior, theory, and development and build competencies in organizational analysis and change.
Topics covered include:
- metaphors of and perspectives on organizations, their strengths and limitations
- the role of the individual, the group, and the organization in a high performance environment
- organizational structures and the organization-environment fit
- corporate social responsibility, sustainability challenges, business ethics, and ethical conduct in bio-based industries
- adapting to current challenges and changes in the institutional environment of agriculture and the food industry
- understanding organizational change, facilitating change processes, and overcoming barriers in the context of agribusiness and the food industry.

Lernergebnisse:
After successfully completing the module students are able to analyze, evaluate, and change organizational management and development practices in the agribusiness and food industry context. Specifically, students are able to
- select and apply suitable theoretical concepts or models of organizational behavior, theory, and development to meet organizational challenges in agribusiness and the food industry
- contrast the strengths and limitations of different perspectives on organizations
- evaluate the potential impacts of various organizational management options on the individual, group, and organizational levels
- identify ethical challenges and options to organizations in agribusiness and the food industry
- adapt organizational practices and policies to sustainability measurement requirements and develop organizational sustainability or CSR (corporate social responsibility) policies
- structure organizational change processes, apply models of organizational change, and evaluate a model’s potential implications
- adapt organizational management and development practices to the specific context in agribusinsess and the food industry.

Lehr- und Lernmethoden:
The course People in Organizations: Managing Change and Sustainability in Agribusiness and the Food Industry has a seminar format based on the case study method. The seminar format is implemented based on case descriptions of problems, challenges, and innovations in agribusiness and food industry supply chains. Through individual document research and individually prepared class discussions and group work, students develop the ability to critically reflect on and apply concepts of organizational behavior, theory, and development in the context of agribusiness and the food industry. Through presentations and concept discussions, students develop in-depth knowledge of exemplary theoretical concepts. During class discussions and group presentations, students reflect on their experiences, prior knowledge, and assignments to develop their conceptual and evaluative skills and to adapt theoretical knowledge to practical challenges

Medienform:
Reading assignments; case descriptions; presentation software; discussion facilitation support media, such as flipcharts and discussion boards; video clips and podcasts.

Literatur:
Selected chapters from
Brown, Donald R. (latest edition). An Experiential Approach to Organization Development, Prentice Hall: Boston.
Daft, Richard L. (latest edition). Organizational Theory and Design. South-Western/Cengage Learning.
Kreitner, Robert and Kinicki, Angelo (latest edition). Organizational Behavior. McGraw-Hill Irwin.
Morgan, Gareth 2006. Images of Organization. Updated ed., Sage: Thousand Oaks/CA.

Modulverantwortliche(r):
Vera Bitsch bitsch@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
People in Organizations: Managing Change and Sustainability in Agribusiness and Food Industry (WZ1563, WI001205) (Seminar, 4 SWS)
Bitsch V [L], Bitsch V, Huhn C, Wagner C
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4082: Plantation Forestry and Agroforestry | Plantation Forestry and Agroforestry

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Aufgrund des Pandemiegeschehens wird die alternative Prüfungsform Klausur, schriftlich (90 min, WZ4082o) angeboten.

The learning outcomes are assessed by an oral examination. Based on specific problem statements the students have to demonstrate their ability to analyze and assess the situation, to understand the origin of the problem and to propose solutions adapted from the methodologies and techniques procured in the course.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
none

Inhalt:
Plantation forestry: Background, Definitions, Plantations in the Context of International Forest Policy, Plantation Forestry Purposes, Plantation Silviculture, Management and Economics; Agroforestry (AF): Introduction (global land-use problems, definitions, terminology), Traditional AF Systems, Environmental, economic and socio-cultural aspects of AF, Interactions in AF systems, Important tree groups in AF (NFT´s, MPT´s, Palms), Planning in AF, Legal aspects
Forest Management for Carbon Sequestration: Role of forests in the global carbon cycle, Possible impacts of climate change on forests, International climate policy, Forest in the Kyoto Protocol (KP), Flexible mechanisms of the KP, REDD and REDD+, Forest management options, Modelling forest sequestration with CO2FIX, Case studies.

Lernergebnisse:
Students will be able to
- understand and evaluate the major issues of plantations in the context of international forest policy,
- explain the fundamental purposes of Plantation Forestry,
- properly deploy the essential techniques of Plantation Silviculture, e.g. for establishment, tending and maintenance
- critically examine plantation projects (management, work volume, economic results).
- understand the fundamental principles and practices of agroforestry land use,
- analyze the interactions among different components of an AF system,
- assess the ecological and economic effects of AF-systems and develop adequate management options,
- address problems in the context of rural development and identify AF-based solutions
- understand the role of forests and forest management activities in the global C-cycle,
- assess forest management options for different purposes within the framework of the international climate policy,
- identify and develop concepts for mitigation projects.

Lehr- und Lernmethoden:
Knowledge and skills are imparted by lectures, group discussions, presentation of case studies and small exercises; the learning methods are learning, reviewing scientific articles, and research reference articles. The lectures will provide theories and basic reference materials which will be deepened and proved by reviewing articles. The achieved skills will be used to develop and discuss solutions for specified problems.

Medienform:
The module includes lectures - providing the theoretical foundations, discussions and small exercises.

Literatur:
ABARE - JaakoPöyry (1999): Global Outlook for Plantations. Australian Bureau of Agricultural and Resource Economics (ABARE) Research Report 99.9, www.abare.gov.au. Evans, J., Turnbull, J. W. (2004): Plantation forestry in the tropics. FAO, (1998): FRA 2000 - Terms and definitions. Forest Resources Assessment Programme, Working Paper 1. FAO (2001): Global Forest Resources Assessment 2000. FAO Forestry Paper 140. Pandey, D. and Ball, J. (1998): The role of industrial plantations in future global fibre supplies. Unasylva 193, Vol. 49, 37 - 43. Sawyer, J., (1993): Plantations in the Tropics. Smith, D.M., Larson, B.C.,Kelty, M.J. and Ashton, P.M.S. (1997): The Practice of Silviculture: Applied Forest Ecology. Smith, J. (2002): Afforestation and reforestation in the clean development mechanism of the Kyoto protocol: implications for forests and forest people. Int. J. Global Environmental Issues 2 (3/4): 322-343. Shepherd, K.R. (1986): Plantation Silviculture. West, P. W. (2006): Growing Plantation Forests. Ashton, M.S. and Montagnini, F. (2000): The silvicultural Basis for Agroforestry Systems. Agroforesty: Principles and Practice: Special issue of Forest Ecology and Management, 45 (1991). Nair, P.K.R. (2012): Agroforestry, the future of global land use. Atangana et al. (2014): Tropical Agroforestry. Springer Verlag

Modulverantwortliche(r):
Annighöfer, Peter; Prof. Dr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Plantation Forestry (Vorlesung, 2 SWS)
Annighöfer P [L], Annighöfer P, Günter S

Agroforestry and Forest Management for Carbon Sequestration (Vorlesung, 2 SWS)
Annighöfer P [L], Annighöfer P, Thom D
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4197: Protected Areas Biodiversity and Management | Protected Areas Biodiversity and Management

Modulbeschreibungsversion: Gültig ab Sommersemester 2020

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Final oral examination of 20 minutes in the field of protected areas biodiversity and its management to examine whether the students have understood the problematic of securing biodiversity in protected areas and are able to verify conservation measurements.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Successful completion of the 1st semester of the Master Program Sustainable Resource Management is recommended

Inhalt:
Biodiversity and protected areas: A worldwide survey on ecozones and altitudinal belts of the word as carriers of natural biodiversity; protection of biological units; IUCN protected areas classification, the European FFH Directive as an example of a continent-wide tool for nature protection.

Habitat analysis and management: Habitat types, tools for protecting habitats, design of management plans, visitor management, best practice examples in sustainable biodiversity and habitat protection.

Lernergebnisse:
On successful completion of the module students are able to:
- to put ecosystems and its utilisation options as well as its threats into a global perspective
- give clear options for further management, both regarding utilisation and protection

Lehr- und Lernmethoden:
Lecture, case studies, practical experiments / demonstrations, discussions.

Medienform:
PowerPoint Presentation.

Literatur:
Jürgen Schultz (2005): The Ecozones of the World: Ecological Divisions of the Geosphere. Springer, Berlin. 459p.

Modulverantwortliche(r):
Prof. Dr. Ralph Kühn; kuehn@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Protected Area Management (Vorlesung, 2 SWS)
Kühn R [L], Gula R, Rödl T

Biodiversity in Protected Areas (Vorlesung, 2 SWS)
Kühn R [L], Gula R, Rödl T
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4202: Political and Social Perspectives of Renewable Resources | Political and Social Perspectives of Renewable Resources

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 105	**Präsenzstunden:** 45

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Oral presentation of the group project work, review paper for a scientific journal. The learning outcomes are assessed by a group project work concerning a selected topic related to the political and social perspectives of renewable resources. Therefore students have to prepare a scientific paper for an international journal of their choice and give a short oral presentation about the work done for the paper, similar to what would be expected in a 15 minute conference presentation.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Knowledge of sustainable resources (materials and energy). Scientific writing.

Inhalt:
In the lectures a number of examples of societal aspects of Sustainable Resource programs will be presented and discussed. Backgrounds are global developments such as urbanization, the rise of countries like China and India, resource availability and technological developments. Case studies deal with tropical forestry and pros and cons of tropical hardwood uses, urban planning, vernacular architecture and the use of renewable resources We take a tour around the world and look at social housing programs in Europe, Brazil and South-East Asia. Furthermore we look at successes and failures in the German/European energy policies in comparison to the United States.

Lernergebnisse:
After this course, students should be able to:

1. Develop SR stimulation programs on country or regional level and priority analysis of renewable resource applications
2. Assess priorities for development and application of renewable resources in countries with different levels of development
3. Critically analyze existing SR programs taking into account social values of stakeholders,
4. Assess impacts of global developments such as urbanization and UN-policies on SR.

Lehr- und Lernmethoden:
Discussion and creativity sessions. Project work evolving in a scientific paper for a journal of choice. Oral presentation.

Medienform:
Lectures, UN-policy notes, Discussion and Creativity sessions.

Literatur:
Tba

Modulverantwortliche(r):
van de Kuilen, Jan Willem; Prof. Dr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Political and Social Perspectives of Renewable Resources (Vorlesung, 4 SWS)
van de Kuilen J [L], van de Kuilen J, Westermayr M
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

LS10003: Remote Sensing of Agriculture and Vegetation | Remote Sensing of Agriculture and Vegetation

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The module assessment is based on a written report (10 pages - A4 single line excluding references; 70% of grade) in combination with a presentation (15 min; 30% of grade). In the report, the students design a strategy of applying remote sensing to gain insights into improving decision making for solving practical problems (e.g., food security, overuse of agrichemicals, biodiversity) in agricultural and vegetation systems.

The students are examined based on the extent to which they are able to:
- situate the problems and strategy in a relevant context
- describe the start of the art and knowledge gaps in the relevant field
- demonstrate deep understanding on methodology
- break down the strategy into workable tasks
- discuss the strategy critically from interdisciplinary perspectives
- show communicative competence

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in agricultural engineering is an advantage

Inhalt:
Remote sensing provides a versatile tool for earth observation and environmental informatics from varied spatial and temporal scales. This module explores the potential and the future trend of the state-of-the-art remote sensing techniques in facilitating the understanding on as well as decision making in agricultural and vegetation systems. We will discuss the fundamentals of remote sensing science, including but not limited the topics below:

- Biophysical-spectral models (e.g., electromagnetic radiation (EMR), radiative transfer, spectral feature extraction, chlorophyll fluorescence);
- Sensor systems (e.g., satellite, drone) and spectral-radiometric measurements;
- Image processing and pattern recognition (e.g., classification, time-series)
- Applications in agriculture and ecology (e.g., crop stress, productivity and biodiversity monitoring)

Through integrated exercise, the students will learn about innovative methods of remote sensing and the use of remote sensing in interdisciplinary fields of agricultural and environmental sciences.

Lernergebnisse:
Upon successful completion of this module, students are able to:
- Understand the important aspects of remote sensing;
- Relate the technologies to research questions and practical problems in other disciplines;
- Apply innovative concepts and methods to agricultural and vegetation systems;
- Evaluate the feasibility of remote sensing from the perspectives of agriculture and ecology;
- Develop a strategy of integrating remote sensing with domain knowledge for decision making in agricultural and vegetation systems;
- Communicate their strategy with good understanding and evidence.

Lehr- und Lernmethoden:
- This module combines lectures, guest seminars, field trips and computer exercises.
- The teaching content will be organized by topics instructed in both theoretical (e.g., seminar) and practical ways (e.g., hands-on demonstrations, computer programing).
- The students will learn the important concepts and methods of remote sensing, as well as the applications in addressing environmental and societal problems, in a highly interactive manner, e.g., discussion in seminars, collaborations in exercises.

Medienform:
- Present and virtual lectures
- PowerPoint, instruction manuals, scripts and codes;
- Field and lab hands-on demonstrations;

Literatur:
Literature will be provided according to individual topics and events.

Modulverantwortliche(r):
Yu, Kang; Prof. Dr. rer. nat.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Remote Sensing of Agriculture and Vegetation (Vorlesung mit integrierten Übungen, 4 SWS)
Yu K [L], Yu K (Camenzind M, Mokhtari A)
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

LS10004: Research Project ‘Smart Agriculture’ | Research Project ‘Smart Agriculture’

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 10	**Gesamtstunden:** 300	**Eigenstudiums-stunden:** 150	**Präsenzstunden:** 150

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The module assessment is based on a report (15 pages – A4 single line excluding references; 70% of grade) in combination with a presentation (15 min; 30% of grade). The students usually hand in the report and do the oral presentation in 4 weeks after the practical work has been concluded.

The grade of the written report is based on:
1) the description of the theoretical background, research questions and objectives of the project (20%);
2) the proper description and use of methods, including statistical analysis (20%);
3) the accuracy and correctness of the results, results interpretation and discussion (30%);
4) the quality of presentation formats (e.g., tables, figures) (10%);
5) the overall structure and quality (20%), particularly examines whether the report is situated and summarized in a concise and coherent manner, in the relevant context of the research area.

The grade of the oral presentation is based on:
1) The explanation of the background, state of the art, research questions/ hypothesis (30%)
2) The accuracy and correctness of methods, data and results interpretation (40%)
3) The relevance and rigor of discussion (20%)
4) The presentation quality and skills, e.g., powerpoint format and clarity (10%)

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
It is recommend to take the course ‘Remote Sensing of Agriculture and Vegetation’

Basic knowledge in plant and soil sciences, agricultural engineering and remote sensing is an advantage
Basic programing skills (e.g., R, Matlab, Python) will be an big advantage

Inhalt:
Smart Agriculture or precision agriculture is considered as a high-tech and interdisciplinary field. Students will learn how to apply and combine multidisciplinary technologies, including but not limited to, field survey, lab biochemical analysis, phenotyping, remote sensing, image analysis and AI techniques to characterize plant traits and their responses to the environment and stresses (e.g., drought). Through specific research questions and objectives, students will explore the potential and limitations of applying the new technologies to solve practical problems, e.g., in the following categories:

- Using unmanned aerial vehicles (UAV) based images (e.g., RGB, multispectral) for high throughput analysis of crop traits (e.g., height, chlorophyll), and for yield estimation and weed detection.
- Using satellite remote sensing images to monitor the spatiotemporal variability in crop health (e.g., nitrogen, water status), biomass and yield in response to environmental and climate changes.
- Correlating leaf and plant optical properties to stresses (e.g., drought) and explaining plant phenotypic and genotypic variations with the aid of hyperspectral data and radiative transfer models.
- Mapping soil spatial variability based on proximal- and remote sensing of soil physical and chemical properties using hyperspectral and multispectral data.
- Applying machine learning (ML) and deep learning (DL) to analyze satellite remote sensing data for crop type and area mapping;
- Applying ML and DL methods to analyze plant images (e.g., UAV) to detect specific objects (e.g., flowers, wheat ears) as a proxy of seed germination, plant health, productivity and biodiversity.

Lernergebnisse:
Upon successful completion of this module, students will be able to:
- understand the theoretical background knowledge related to smart agriculture;
- define research questions for their selected topics in the related research area;
- apply sensor and imaging techniques for data collection in the field and laboratory;
- acquire computational and artificial intelligence (AI) skills for big data handling and data evaluation;
- interpret the results of statistical analysis and machine learning models;
- present the research findings in a concise manner in written and oral form;
- gain competence in applying proximal- and remote sensing, and AI technologies in precision agriculture.

Lehr- und Lernmethoden:
- The students conduct a semester (normally three months) research project. The schedule of field or lab work can be adjusted according to the student’s curriculum.

- Three to five students team up as a group and define the research topic and proposal through discussion with the lecturer.
- The lecturer teach students through theoretical (e.g., seminar) and practical instructions (e.g., hands-on demonstrations, computer exercises).
- Students conduct the project through teamwork (3-5) and collaborations with doctoral students.
- Periodic meeting with the supervisor to discuss the progress of project.
- Journal club discussing related scientific articles with the lecturer and peers.
- Seminars to present project output and exchange with fellow students.

Medienform:
- PowerPoint, instruction manuals, scripts and codes;
- Field and lab hands-on demonstrations;
- TUM-Moodle, Zoom

Literatur:
Literature will be provided according to individual projects.

Modulverantwortliche(r):
Yu, Kang; Prof. Dr. rer. nat.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Research Project 'Smart Agriculture' (Projekt, 10 SWS)
Yu K [L], Yu K (Mokhtari A, Camenzind M)
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

LS10007: Remediation of Contaminated Sites – Lecture and Seminar | Remediation of Contaminated Sites – Lecture and Seminar

Modulbeschreibungsversion: Gültig ab Sommersemester 2022

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The type of assessment of the module will take the form of a Klausur and a Presentation, each of which will count for 50% of the final grade.
The competences acquired in the lecture are subject of a written exam (Klausur 60 min, max. 20 points, no supporting materials), where the students demonstrate their ability to identify problems and find solution strategies. In the seminar, the students prove with an oral presentation (20-30 minutes, max. 10 points) their ability to analyze selected case studies about contaminated sites, to develop remediation concepts and to explain their understanding to their fellow students demonstrating their communication skills in front of an audience. The presentation is accompanied by an essay (6-8 pages, max. 10 points).
The points of both the Klausur and Presentation are summed up and converted to the final module grade according to a linear system (50 % = 4.0; 100 % = 1.0).

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Knowledge in natural sciences (chemistry, physics and biology) is necessary. The module "Introduction to Soil Science" (also parallel in the same semester) is recommended.

Inhalt:
Lecture: Bundesbodenschutzgesetz (Federal Soil Protection Act), investigation of contaminated sites, sector-specific contaminations, assessment of contaminants, risk potential, ecotoxicological tests, investigation methods, sampling strategies, analyses, remediation objectives, decontamination procedures, rehabilitation and remediation procedures.
Seminar: Investigation and remediation of contaminated sites by means of selected case studies

Lernergebnisse:
After attending the lecture, the students are able to understand legal regulations dealing with contaminated sites. They know adequate procedures for the investigation of contaminated sites and suspected contaminated sites as well as for the remediation of contaminated sites. They are able to evaluate the hazard potential of a contaminated site in terms of pollutant type and emission pathway and understand the different investigation methods. After attending the seminar, the students are able to analyze studies about contaminated sites, to prepare remediation concepts and to evaluate applied remediation measures.

Lehr- und Lernmethoden:
Manifold site contaminations occur in our environment and plenty different remediation methods exist. The overview is best given in a lecture.
Professionals working in soil remediation must thoroughly understand a specific contamination problem and develop individual remediation plans. This is the purpose of the seminar, where students work independently and in groups, and then present and discuss the results.

Medienform:
Presentations

Literatur:
Lecture: presentation notes
Seminar: bibliographies to the seminar topics

Modulverantwortliche(r):
Bucka, Franziska, M.Sc. franziska.bucka@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Remediation of Contaminated Sites - Regeneration of contaminated soils (Vorlesung, 2 SWS) Bucka F

Remediation of Contaminated Sites – Investigation and remediation methods (Seminar, 2 SWS) Heister K, Bucka F
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

POL40100: Ringvorlesung: Politics & Technology | Introductory Lecture: Politics and Technology

Modulbeschreibungsversion: Gültig ab Sommersemester 2020

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Current notice in view of the restricted presence operation due to the CoViD19 pandemic: If the general conditions (hygiene, distance rules, etc.) for a presence test are not available, the planned form of examination can be switched to electronic (remote) testing in accordance with §13a APSO. The decision about this change will be announced as soon as possible, but at the latest 14 days before the examination date by the examiner after consultation with the responsible examination board.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Keine

Inhalt:
The module is intended as an introduction to the questions and research being addressed in the main thematic areas of the master's program: big transformations and their environmental, technological, and social dimensions; democracy in a digital age; and global governance, ethics and technology. The links between these areas and research areas found in the TUM, such as economics and policy, digital technologies, social responsibility and corporate governance, and urbanization, mobility, and energy will be explained.

Lernergebnisse:
After participating in the module, students will have a strong overview of the kinds of research questions being addressed by faculty in the HfP. They will be be knowledgeable about some of the big questions driving the study of politics and research methods and theories which are used to address those questions: What role does the state play in technological innovation? How well

do different political systems address major challenges like climate change, biodiversity loss, and ocean acidification? How is support for democracy impacted by growing economic inequalities? How might new technologies alter forms of societal participation in governance processes?

Lehr- und Lernmethoden:
The module is offered in the form of two seminars, each dealing with different, but complementary thematic areas. One will focus on big questions for politics in a world of rapidly changing technologies, globalization, migration, and challenges to democracy. The other will look at major policy problems (the Energiewende, Resource depletion, urbanization) and how they are being addressed by governments, industrial actors, and civil society.

Medienform:
Online-Reader, PowerPoint

Literatur:
A reader of seminar texts with up-to-date and cutting edge scientific literature will be made available at the start of the semester.

Modulverantwortliche(r):
Schreurs, Miranda; Prof. Dr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
(POL40100) Introduction to Politics, Technology & Sustainability (Vorlesung, 4 SWS)
Schreurs M (Mohammed N, Schmid H)
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WI001255: Ringvorlesung Erneuerbare Energiesysteme im Globalen Süden | Lecture Series Renewable Energy Systems in the Global South

Modulbeschreibungsversion: Gültig ab Sommersemester 2020

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 135	**Präsenzstunden:** 45

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Written exam of 60 minutes:
- In multiple-choice questions and short questions, it is examined if the students are able to name and explain facts regarding renewable energy technologies, decentralized energy systems and their utilization and operation in the Global South correctly.
- In computational tasks, it is examined if the students are able to classify relevant location parameters correctly and perform calculations on renewable energy technologies correctly in order to design decentralized energy systems in the Global South according to the framework conditions of a certain location.
- In text tasks, it is examined if the students are able to classify and evaluate technological, economic and social factors influencing renewable energy technologies, decentralized energy systems and their utilization and operation in the Global South correctly.
- The exam is graded.
- Up to 20% of the exam can be multiple-choice questions.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
- Bachelor degree in an engineering study program or a study program, which included technological/engineering aspects (such as B.Sc. Management & Technology)
- Interest in various renewable energy technologies, decentralized energy systems and their utilization and operation in the Global South
- Interest in the socio-economic factors influencing the utilization of renewable energies in the Global South

Inhalt:
Overview of renewable energy technologies including their functionality, their technological and economical assessment, their integration in decentralized energy systems as well as business concepts for their utilization in the Global South:
- Renewable energy systems in the Global South - Why and how?
- Small-scale solar thermals and photovoltaics
- Small-scale hydro-power
- Small-scale wind-power
- Small-scale biogas systems
- Battery storages
- Electrical components of mini-grids
- Rural electrification planning through Geo Information Systems
- System sizing through least-cost modelling
- Sustainable energies and entrepreneurship in the Global South
- Sustainable enterprises for Renewable Energies in the Global South
- Rural electrification projects in the Global South

Lernergebnisse:
After successfully completing the module, students are able to
- Name and explain facts regarding renewable energy technologies, decentralized energy systems and their utilization and operation in the Global South.
- Perform calculations regarding renewable energy technologies in order to be able to design decentralized energy systems in the Global South.
- Classify and evaluate technological, economic and social factors influencing renewable energy technologies, decentralized energy systems and their utilization and operation in the Global South.
- Develop concepts for decentralized energy systems in the Global South based on the technological, economic and social framework conditions of a certain location.

Lehr- und Lernmethoden:
Lectures and presentations by various researchers from TUM as well as entrepreneurs and other experts from the field of Renewable Energies in the Global South.
In exercise lessons, the taught knowledge of the lectures are applied to exemplary topics. After each lecture, the students conduct these exercises in homework and afterwards, these are discussed during the upcoming exercise lesson. Most of these exercises are calculating tasks about the technical components, but there are also some exercises regarding the financial assessment of renewable energy technologies. The exercises are not graded.

Medienform:
The following media types are used:
- Computer-aided presentations for the lectures
- Exercises
- Discussion of provided literature

Literatur:
- Presentation slides of the speakers
- Solutions of exercise lessons
- Other literature recommended by the speakers

Modulverantwortliche(r):
Belz, Frank-Martin; Prof. Dr. oec.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ1674: Research Methods and Economic Research Project | Research Methods and Economic Research Project

Modulbeschreibungsversion: Gültig ab Sommersemester 2015

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Examination Duration (in min.): 30.
The course grade consists of two parts: 50% project report and 50% in-class grade. The in-class grade consists of equal parts each, proposal presentation, project results presentation, peer review of another student's proposal, peer review of another student's project results, and discussion of applications of economic concepts.
Justification: Students demonstrate their ability to apply economic concepts through class discussions and development of project ideas.
Students demonstrate their ability to develop an economics research projects through the stages of proposal presentation, result presentation, and project report.
Students demonstrate their ability to evaluate other researchers' proposals and results in a constructive manner through presentations of reviews.
Students demonstrate their ability to manage resources, and deadlines through timely submission of the enumerated tasks in stages throughout their research projects.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
BSc. Degree. Prior knowledge of basic ideas of economics and management recommended.

Inhalt:
The module provides master level students with an advanced understanding of the research process, its quality criteria, and the application of economic concepts to questions of food and agriculture. Key economic ideas are applied to everyday questions in class discussions based on economic texts, podcasts, and others. The development, execution, publication, and review of

disciplinary and interdisciplinary research is explained in lectures and carried out by each student from beginning to end.
Steps include developing project ideas and research questions; using peer-reviewed literature to frame a student project; designing research plans with the appropriate methods and suitable techniques of data collection; structuring, preparing, presenting, and critically reviewing research proposals; data collection, data analysis, and data presentation; discussion and conclusions based on reflecting own empirical research in the light of the literature; disciplinary, professional, and ethical quality criteria of research in economics and management

Lernergebnisse:
Students are able to apply economic ideas to questions related to food and agriculture in everyday life.
Students are able to develop and execute an economic research project in the field of agriculture, horticulture, and food.
Specifically, students are able to develop a project idea, develop a research question and objectives based on the project idea and the related scientific literature, and create a research plan, including the suitable combination of research methods and techniques; defend a research proposal based on the research plan.
Students are able to evaluate other (student) researchers' proposals and present such evaluations in a suitable form, orally.
Furthermore, students are able to apply their research plan through data collection, data analysis, and presentation of research results, in oral and written form; and are able to evaluate other (student) researchers' research process, results, and conclusions.
Students are able to manage resources and deadlines.

Lehr- und Lernmethoden:
Lectures, class discussions, and guided student project development and project evaluation (project proposal, proposal review, project results, results review, and research report).

Medienform:
Presentation slides, websites, articles and short texts, multi-media (podcasts, video clips), student presentations, and reviews.

Literatur:
Hartford, Tim (latest edition). The Undercover Economist. Random House: New York.
O'Leary, Zina (latest edition). The Essential Guide to Doing Your Research Project. Sage: Los Angeles.
Committee on Science, Engineering, and Public Policy,
National Academy of Sciences, National Academy of
Engineering, and Institute of Medicine (latest edition). On Being a Scientist: A Guide to Responsible Conduct in Research.

Modulverantwortliche(r):
Vera Bitsch bitsch@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Research Methods and Economic Research Project (WZ1559, WZ1674) (Seminar, 4 SWS)
Bitsch V [L], Bitsch V, Carlson L, Wagner C
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2720: Renewable Energy Technologies | Renewable Energy Technologies

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The examination consists of a written test, where the students have to proof that they understand and remember the basic technical principles related to energy production and the working principles of the presented renewable energy technologies, as well as the related ecological and economical properties and frame conditions. The students have to answer questions, but may also be asked to do calculations, complete figures or prepare sketches.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
General understanding of natural science, mathematics and basics of technology.

Inhalt:
The course provides an overview of the basics of thermodynamics and the principles of energy conversion. Energy conversion and its importance for the economy is discussed. Because of their transitional character due to the German “Energiewende”, the course focusses on the European and German energy systems. The international students in the course are expected to support the lecture with their experiences from abroad.
Basic technical principles of energy production, efficiencies, costs and environmental impacts will be understood. The focus lies on the following areas: solar, wind, water and geothermal energy conversion.
In order to complete the picture, also storage and fossil fuel technologies will be discussed. The students will understand their role and their contribution to balancing energy production and demand.

Lernergebnisse:
At the end of the course, the students understand the technical principles of renewable energy conversion systems.
They are able to interpret energy scenarios and solve simple problems associated with a high renewable energy share and its implications on society.
The students can estimate the importance of distinct technologies for a sustainable energy supply.

Lehr- und Lernmethoden:
The course provides an overview of the basics of thermodynamics and the principles of energy conversion. Energy conversion and its importance for the economy is discussed. Because of their transitional character due to the German “Energiewende”, the course focusses on the European and German energy systems. The international students in the course are expected to support the lecture with their experiences from abroad.
Basic technical principles of energy production, efficiencies, costs and environmental impacts will be understood. The focus lies on the following areas: solar, wind, water and geothermal energy conversion.
Lecture with integrated exercises and teamwork, as well as discussions to improve understanding.

Medienform:
Power point presentation, black board, Videoclips

Literatur:
Tba

Modulverantwortliche(r):
Dr. Doris Schieder - Lehrstuhl für Chemie Biogener Rohstoffe doris.schieder@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Renewable Energy Technologies (Vorlesung, 4 SWS)
Wieland C [L], Wieland C
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2737: Remote Sensing and Image Processing | Remote Sensing and Image Processing

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 80	**Präsenzstunden:** 70

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Achievements will be assessed by exercises, a presentation and a final report. On behalf of home exercises the students get a first insight into concepts of image analysis. “Hands on” exercises with state of the art software packages are employed to train the main image processing steps and to assess the understanding of the students in implementing the basic concepts of remote sensing from data take to data analysis. Regular discussions with the tutor measure the student’s ability to develop an idea from initial concepts to the complete picture within a given timeframe, delivering interim results at relevant milestones (35%). On behalf of a presentation of a topic related to remote sensing the student’s ability to understand a technical/scientific subject, to analyze and evaluate facts and factors of influence, to summarize the subject and present it to an audience, and to conduct a discussion about the presented subject is assessed. With the final report the students demonstrate that they have gained deeper knowledge of the specific image analysis software packages and its components, of differing analysis concepts and that they are prepared to evaluate an existing situation as imaged by the respective remote sensing data set. They demonstrate further that they are able to create new geodata layers appropriated to be analyzed in an integrating GIS environment (65%).The grade weights of module examination components correspond to the weighting factors given in brackets.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Module "Inventory Methods and GIS" of the 1th semester of the Master Program "Sustainable Resource Management" passed, computer skills at least at working level .

Inhalt:
The implementation of data interpretation and information extraction concepts and techniques is trained "hands on" with the help of advanced image processing and analysis programs. Topics: 1. Introduction to image processing concepts; 2. Implications of air- and space borne data takes; 3. Data types: Digital aerial photographs, high to very high resolution multispectral and hyperspectral scanner data, LIDAR data; 4. Development of interpretation keys; 5. Exercises on data pre-processing; 6. Unsupervised and supervised classification concepts, pixel-based, object based classification strategies; 7. Exercises on land use/land cover classification; 8. Basic verification concepts; 9. Exercises on the extraction of bio-geo-chemo-physical parameter from RS data; 10. Change detection concepts; 11. Interrelation of Remote Sensing with GIS; 12. Access and data download from geodata provider.

Lernergebnisse:
At the end of the Remote Sensing and Image Processing module (RSIP) the students are able to:
- decide which data set is most appropriated to solve his thematic task, - access data bases, download and open a data set for image processing, - geocode/georeference digital data sets,
- develop appropriated interpretation keys fitting the data set and the targeted thematic goal,- visualize and enhance the data set for interpretation, - extract spectral signatures, - calculate indices on behalf of the data,
- learn how to extract bio-geo-chemo-physical parameter from the data set, - perform unsupervised and supervised classifications, - proof the quality of the results by an accuracy assessment, - perform a change detection study, - export the results as GIS layer.

Lehr- und Lernmethoden:
By using advanced image processing software packages the theoretical explained concepts are exercised “hands on” and discussed on basis of different data types applying the “just in time teaching (JiTT)” technique; the practical courses are prepared by homework (presentation of specific related topics, exercises); the short presentations will be given during the courses, contents, layout and style discussed and narrated; the home exercises explained in close relation to the computer exercises just done. The definition of the problem to be solved by image analysis techniques and the development of appropriated solutions needs research of reference materials. The final outcome of the courses, the classification result, will be used as basis for the Module “Application Study” of the concentration field “Landscape Management”.

Medienform:
Image processing software and tutorials, prepared exercises, different data types

Literatur:
The literature recommended within the Modules "Inventory Methods and GIS", "Remote Sensing and Image Processing", www.wiau.man.ac.uk/courses/cvmsc/Terminol.htm#SplitMerge;http://www.pfc.cfs.nrcan.gc.ca/landscape/inventory/wulder/large_area_rs/index.html; http://www.pfc.cfs.nrcan.gc.ca/landscape/inventory/wulder/hirespres.html; Uni Zürich, RSL: http://www.geo.unizh.ch/rsl2/; EARSeL: http://www-earsel.cma.fr/; http://www.ccrs.nrcan.gc.ca/ccrs/

eduref/tutorial/indexe.html; http://observe.ivv.nasa.gov/nasa/education/reference/main.html; http://rst.gsfc.nasa.gov/starthere.html

Modulverantwortliche(r):
Dr. Thomas Schneider – Fachgebiet für Waldinventur und nachhaltige Nutzung
tomi.schneider@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Remote Sensing and Image Processing (Vorlesung, 6 SWS)
Mengesha M, Schneider T
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

BGU38031: Sanitäre Versorgung im globalen Süden | Sanitation in the Global South

Modulbeschreibungsversion: Gültig ab Wintersemester 2018/19

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 3	**Gesamtstunden:** 90	**Eigenstudiums-stunden:** 60	**Präsenzstunden:** 30

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Die Prüfungsleistung besteht aus einer Projektarbeit (60%) und einer damit verbundenen Abschlusspräsentation (40%).
Im Rahmen der Projektarbeit werden die Studierenden anhand eines Abschlussberichtes zu einer Fallstudie, einer Kleinstadt in Nordindien, die im Unterricht vermittelten Inhalte anwenden und ihre Ergebnisse kritisch bewerten. Die Inhalte umfassen das Verständnis zu (i) der Notwendigkeit sanitärer Versorgung (basierend auf gesundheitlichen Aspekten und den Sustainable Development Goals), (ii) Analyse- und Planungsmethoden zu sanitären Projekten (unter Einbeziehung der Stakeholder und Planungskonzepten wie z.B. CLUES und CLTS), (iii) Sanitärsystem-Designs und (iv) Methoden zu Management und Finanzierung (unter Berücksichtigung von klassischen als auch innovativen Finanzierungmethoden). Durch eine Abschlusspräsentation des Projektes zeigen die Studierenden, dass sie ihre Ergebnisse vor einem Fachpublikum strukturiert und verständlich darstellen können.
Die Note für den Abschlussbericht und die Präsentation setzt sich aus den individuellen Beiträgen der jeweiligen Teammitglieder (4 Studierende je Team) zusammen. Hierbei wird besonderes Augenmerk auf die logische Strukturierung, die Darstellung der Ergebnisse und die Anwendbarkeit des Entwurfs auf den Fallstudienbereich gelegt.

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:
• Natürliche Aufbereitungsverfahren
• Water and Wastewater Treatment Engineering
• Wastewater Treatment

Inhalt:
• Identifizierung der negativen Auswirkungen unzureichender sanitärer Versorgung / Darlegung der Notwendigkeit guter sanitärer Versorgung
• Identifizierung aller relevanter Akteure (Stakeholder-Analyse) und Präsentation adäquater Methoden / Anreize für Verhaltensänderungen
• Entwicklung eines ganzheitlichen ingenieurtechnischen Sanitärsystems
• Anwendung von Planungsstrategien, wie z.B. CLUES (“community led urban environment sanitation”) und CLTS (“community led total sanitation”)
• Vorstellung von Konzepten zur Finanzierung von sanitären Projekten
• Untersuchung und Anwendung von Analyse- und Planungsmethoden für sanitäre Projekte

Lernergebnisse:
Nach erfolgreicher Teilnahme an diesem Modul sind die Studierenden in der Lage;
• die Folgen unzureichender sanitärer Einrichtungen, die Komplexität und die sanitären Herausforderungen in verschiedenen Siedlungen (städtisch / Vororte - Slums / ländlich) zu beschreiben
• „Sustainable Development Goals“ (SDGs) und den Status quo der internationalen Zusammenarbeit im globalen Kontext zu nennen
• Die Stakeholder, die an einer erfolgreichen Sanitärplanung beteiligt sind, zu identifizieren und verschiedene Anreize für Verhaltensänderungen zu skizzieren
• Die Unterschiede zwischen Planungskonzepten z.B. CLUES und CLTS zu identifizieren und diese Ansätze auf die Fallstudien anzuwenden
• Die Sanitäranalyse- sowie andere Planungsmethoden auf die Fallstudien anzuwenden und ein ingenieurtechnisches Sanitärsystem für eine Fallstudie zu entwerfen
• Sowohl klassische als auch innovative Methoden zur Finanzierung von Sanitärprojekten zu beschreiben

Lehr- und Lernmethoden:
Dieses Seminar ist als eigenständiges Wahlfach konzipiert. Während der Vorlesungen werden die Studierenden über soziale, technologische und managementbezogene Aspekte erfolgreicher sanitärer Projekte im globalen Süden informiert. Zusätzlich werden externe Dozenten mit Berufserfahrung im Bereich der internationalen Zusammenarbeit für Vorträge eingeladen. Die Studierenden werden zusätzlich Lernmaterialien und Literatur zur Vertiefung ihres Wissens erhalten. Außerdem erhalten die Studierenden Informationen und Daten zu Fallstudien, welche für die Projektarbeit benötigt werden. Die Projekte zu den jeweiligen Fallstudien werden im Teamwork von jeweils vier Studierenden selbständig bearbeitet. Die Studierenden haben die Möglichkeit, Fragen oder Vorgehensweisen mit dem Projektteam während der Tutorials vor der endgültigen Einreichung des Projekts zu besprechen. Die Ergebnisse aus dem Endbericht und der Präsentation werden abschließend mit dem Projektteam diskutiert.

Medienform:
PPT Präsentationen

Literatur:
Gensch, R.; Jennings, A.; Renggli, S.; Reymond, P. Compendium of Sanitation Technologies in Emergencies; 2018.

United Nations Children Fund; World Health Organisation. Progress on Drinking Water, Sanitation and Hygiene; 2017.

Lüthi, C.; Morel, A.; Tilley, E.; Ulrich, L. Community-Led Urban Environmental Sanitation Planning (CLUES); Eawag-Sandec, WSSCC, UN-HABITAT, 2011.

Tilley, E.; Ulrich, L.; Lüthi, C.; Reymond, P.; Zurbrügg, C. Compendium of Sanitation Systems and Technologies; 2008.

Modulverantwortliche(r):
Uwe Hübner u.huebner@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WI001165: Sustainable Entrepreneurship - Getting Started | Sustainable Entrepreneurship - Getting Started

Modulbeschreibungsversion: Gültig ab Sommersemester 2017

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The module assessment consists of project work. Students are divided into teams of 3 to 5 students. Starting from the student's initial idea, each team has to develop a sustainable business model over the term. By working in a team, students demonstrate their ability to manage resources and deadlines together and to be able to complete their tasks in a team environment.
Each team will work on assigned tasks. Each group member has to contribute to the final group presentation (a 15 minutes pitch per team, 25%) that will take place during the last session of the term. By presenting their sustainable business plan, students demonstrate they are capable of presenting their business model in a clear and comprehensible manner to an audience. In addition, each team member will work on a section of the final written project report, describing and analyzing the sustainable business plan of the team. The written paper is due four weeks after the oral presentation (max. 8,000 words, 75%). By writing the project report students demonstrate that they are able to elaborate more in-depth on their sustainable venture. They also show their ability to apply the theory and real-life examples provided to them to their own idea and business model.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Modules in entrepreneurship, corporate sustainability and/or sustainability marketing are recommended.

Inhalt:
Whether it is tackling climate change, resource degradation or social inequalities - responding to sustainability issues constitutes the biggest challenge for businesses in the 21st century. Embracing a great range of industries including food, energy or textiles, the field of life sciences is a key area for sustainability. Since the production of these goods accounts for an extensive

use of resources, there is great potential for effecting real improvements on a way towards more sustainable production and lifestyles. In this module we want to invite and inspire students to make a difference. We introduce them to the theory and practice of sustainable entrepreneurship, pursuing the triple bottom line of economic, ecological and social goals. We present the sustainable business model canvas as a tool for the students to explore their own ideas and to develop a sustainable business in the area of life sciences. Adopting a step-by-step approach, the following topic will be covered (all topics will be explained in general and then discussed in the context of life sciences):

1) The nexus of entrepreneurship and sustainable development
2) An overview of the theory and practice of sustainable entrepreneurship
3) Social and ecological problems as opportunities for sustainable entrepreneurship
4) Developing a sustainable customer value proposition
5) Describing key activities, resources and partners
6) identifying revenues and costs
7) Consolidating all parts in a lean and feasible business model
8) Pitching and presenting a business model

Lernergebnisse:
Upon successful completion of this module, students will be able to (1) discuss and (2) evaluate the socio-economic challenges of the 21st century. They will be able to (3) evaluate the concept of sustainable entrepreneurship as a means for addressing these complex sustainability issues. More specifically, students will be able to (4) perceive socio-ecological problems as opportunities for sustainable entrepreneurship and to (5) generate their own ideas for a sustainable venture. In addition, participants will be able to (6) transfer the provided theory and examples to their own idea and (7) design their own business model. Students will (8) have gained experience and new skills in presenting in front of a large audience. Finally students are able to exchange in a professional and academic manner within a team. They show that they are able to integrate involved persons into the various tasks considering the group situation. Furthermore the students conduct solution processes through their constructive and conceptual acting in a team. They can make this contribution in a time limited environment.

Lehr- und Lernmethoden:
The module is a seminar which intends to familiarize the student with the theory and practice of sustainable entrepreneurship. Since the main goal of the module is to ignite entrepreneurial thinking and passion, as well as to provide the students with the required know-how to get started, the module has an interactive format with excursions and a project work in small groups. A special feature of the module is the co-teaching by an academic and a practitioner with a mutual interest in the theory and practice of sustainable entrepreneurship.

Medienform:
Presentations, slides, cases, links and further literature will be provided via www.moodle.tum.de

Literatur:
The module is based on a few key scientific papers and practical tools such as the business model canvas. These form the basis for classroom discussions and are to be used for developing an own business model. All materials are provided as pdf files in TUM Moodle (https://www.moodle.tum.de).
Students should be familiar with the United Nations' Sustainable Development Goals (SDGs) and the basics of the business model canvas:
United Nations Sustainable Development Goals: http://www.un.org/sustainabledevelopment/sustainable-development-goals/
Business Model Canvas:
Osterwalder, A. & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. Wiley: New Jersey, US.

Modulverantwortliche(r):
Belz, Frank-Martin; Prof. Dr. oec.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Sustainable Entrepreneurship - Getting Started (Life Scienes) (WI001165) (Limited places) (Seminar, 4 SWS)
Belz F [L], Rocchino R, Terveen N
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ1921: Strategy, Supply Chain Management, and Sustainability in Agribusiness and the Food Industry | Strategy, Supply Chain Management, and Sustainability in Agribusiness and the Food Industry

Modulbeschreibungsversion: Gültig ab Wintersemester 2019/20

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The assessment type for the module is a graded learning portfolio (100%). The portfolio includes memorandums addressing 9-10 of the case studies discussed in class; and a learning statement addressing conceptual, scientific and personal learning. Through the case memorandums, the students show the ability to discuss the assigned case questions by selecting and applying suitable theoretical concepts to supply chain management and sustainability challenges in the specific context of agribusiness and the food industry. In the learning statement, students demonstrate the ability to reflect on the semester long learning process and summarize the insights gained.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Solid economic and management background; knowledge of basic concepts of strategic analysis, planning, and management (e.g., industry analysis, horizontal and vertical coordination, and SWOT), as well as the ability to apply these concepts; furthermore, knowledge of value chain management is required (e.g., theoretical background, supply chain dynamics, actors and partnerships, governance). Successful completion of a management course on M.Sc. level required, e.g., agribusiness management or value chain management. Medium level experience in desk research and scientific writing is required.

Inhalt:
The module builds on key concepts of supply chain management, strategy, and sustainability to provide master level students with the competency to evaluate pertinent issues in agribusiness and food industry supply chains.

Topics covered include:
- value propositions, creating and capturing added value in agribusiness and the food industry
- management of customers, suppliers, and other stakeholders
- innovation in supply chains, sustainability as an innovation, sustainable supply chains
- CSR (corporate social responsibility) and sustainability measurement
- implementation of a sustainability strategy, as well as costs and benefits of sustainable practices in agribusiness and the food industry
- ethical issues in supply chain management.

Lernergebnisse:
After successfully completing of the module, students are able to evaluate processes of supply chains management in agribusiness and the food industry.
Specifically, students are able to
- evaluate value propositions, as well as plans for creating and capturing value
- evaluate the management of customers, suppliers, and other stakeholders
- independently choose scientific models or concepts relevant to the analysis process of agricultural and food industry supply chains and justify their choice
- evaluate the implementation of a CSR concept or sustainability strategy, and monitor its effects on operations, suppliers, associates, and customers
~ identify and analyze ethical issues in supply chain management and to recommend how to apply ethical practices.

Lehr- und Lernmethoden:
The course Strategy, Supply Chain Management, and Sustainability in Agribusiness and the Food Industry has a seminar format based on the case study method. The seminar format is implemented based on case descriptions of problems, challenges, and innovations in agribusiness and food industry supply chains. Through individually prepared class discussions and group work, students develop the ability to critically reflect and apply concepts of strategy, supply and value chain management, and sustainability requirements in the context of agribusiness and the food industry. During class discussions and group presentations, students reflect on their experiences, prior knowledge, and assignments to develop an in-depth understanding of current challenges in supply chains and how to address the.

Medienform:
Reading assignments; case descriptions; presentation software; discussion facilitation support media, such as flipcharts and discussion boards; video clips and podcasts.

Literatur:
Current articles from scientific journals as appropriate.
Selected chapters from
Bouchery, Corbett, Fransoo, and Tan (2017): Sustainable Supply Chains: A Research-Based Textbook on Operations and Strategy. Springer: Berlin, Heidelberg, Germany.
Pullmann and Wu (2011): Food Supply Chain Management: Economic, Social and Environmental Perspectives. Routledge, New York, US.

Modulverantwortliche(r):
Bitsch, Vera; Prof. Dr. Dr. h.c.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Strategy, Supply Chain Management, and Sustainability in Agribusiness and the Food Industry (Seminar, 4 SWS)
Bitsch V [L], Bitsch V, Carlson L, Huhn C, Wagner C
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2727: Sustainability of Food Chains | Sustainability of Food Chains

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Combination of Poster and oral presentation provides to assess the students ability to conduct a life cycle analysis of a special food product. The poster needs a very concentrated presentation, focus on the important information and factors and shows the students capability to understand the principles of the LCA and the special food production process.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Attendance in Module 4209 and 4210 is recommended.

Inhalt:
Food chains of processed food, from agricultural production via processing to packed product unit in a food store, principles of life cycle analysis, assessment criteria, energy input output ratio, energy efficiency, CO2 emission, carbon footprint, virtual water
LCA calculation and calculation program (Umberto).

Lernergebnisse:
At the end of the module the students are able to understand food chains. They can describe and apply life cycle analysis to processed food products. They are able to assess energy and emission impact of different crop and animal production system and processing procedures. The will get basic skills of the software Umberto.

Lehr- und Lernmethoden:
Teachers Presentations Life cycle analysis, food chain, energy, CO2 emission and water impacts, students contributions, special aspects of processing paper reading for contributions to group discussions and outline of the final presentation.

Medienform:
Presentation notes, computer program.

Literatur:
Tba

Modulverantwortliche(r):
Dipl. Ing. Max Kainz - Lehrstuhl für Ökologischen Landbau und Pflanzenbausysteme Liesel Beckmann Str. 2, 85354 Freising, 08161/71 - 3034, kainz@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Sustainabilityof Food Chains
Max Kainz
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2728: Sustainable Land-Use Management | Sustainable Land-Use Management

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
In a Power Point (or comparable tool) supported oral presentation the students can show, how they identify a special issue of farm management related to terms of sustainability. In the further outline of the presentation, the students will show how to discuss the topic based on recorded results from published papers, to explain conclusions and to suggestsolutions on improved sustainability.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
Agricultural systems and their relation to natural and human resources; site, economic and social conditions, regional and global,
adaptation of farm management techniques to principles of sustainability, research and scientific results, terms of politics and social debate, aims and scenarios for future development
Topics selected participative with the students.

Lernergebnisse:
On successful completion of the module students are able to identify special problems of sustainability in farm management, economic and social conditions, to analyze the technical, social and economic impacts and to evaluate them on the background of criteria of sustainability. They will be able to create solutions for critical impacts.

Lehr- und Lernmethoden:
Lectures provide facts, background and theoretical foundations.

Papers have to be read and used in group work.
Group work.

Medienform:
Power Point Presentations
Flip Chart
Pin wall, Metaplan technique

Literatur:
Tba

Modulverantwortliche(r):
Dipl. Ing. Max Kainz; Dr. Hans-Jürgen Reents - Lehrstuhl für Ökologischen Landbau und Pflanzenbausysteme, Liesel Beckmann Str. 2, 85354 Freising, 08161/71 - 3778, kainz@wzw.tum.de, reents@wzw.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Case Studies of Land-Use Management
Hans-Jürgen Reents, Max Kainz
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2734: Soil Protection | Soil Protection

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
In an oral exam of 30 minutes duration, students demonstrate in a scientific discussion by answering questions without helping material their broad and deep understanding on how to protect soils. The understanding of soils, as achieved in the modules "Introduction to soil science" and "World soil resources", is implicitly part of the oral exam.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
The successful completion of the module "Introduction to Soil Science" or equivalent skills are required. The successful completion of the module "World Soil Resources" is recommended.

Inhalt:
Principles of soil degradation, the world food problem, highly erodible soils, semi-arid environments (including irrigation and salinization problems), kaolinitic soils, shifting cultivation, organic and mineral fertilization, agroforestry, land use and greenhouse gases, soil functions, organic pollutants, inorganic pollutants (heavy metals), radionuclides, pesticides, pathways of pollutants, sorption, precipitation, co-precipitation, acidification, ways to assess the mobility of pollutants, remediation of brownfields.

Lernergebnisse:
The students are able to apply their knowledge of soils, as achieved in the modules “Introduction to Soil Science” and “World Soil Resources”, to develop strategies of soil protection. They understand the major environmental factors that determine the food production in the world. They are able to address the specific problems of highly erodible soils, semi-arid land and kaolinitc soils and to design adequate land-use methods. The students understand the major factors that determine the fate of substances in soil. They are able to analyze and forecast the fate of heavy metals, organic

pollutants and radionuclides in soil and are familiar with important techniques for managing and remediating brownfields.

Lehr- und Lernmethoden:
Lecture, discussions

Medienform:
Presentation notes.

Literatur:
Blanco, H., Lal, R. (2008): Principles of soil conservation and management. Diamond, J. (1998): Guns, germs and steel. A short history of everybody for the last 13,000 years. Mirsal, I. (2008): Soil Pollution.

Modulverantwortliche(r):
Schad, Peter; Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Bodenschutz - Organische und anorganische Schadstoffe in Böden (Vorlesung, 2 SWS)
Bucka F

Soil Protection and World Food Production (Vorlesung, 2 SWS)
Schad P
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2936: Sustainable and Environmental Regulations | Sustainable and Environmental Regulations

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Successful completion of the course will be based in both seminars on the quality of the presentation in the seminar and a written executive summary on the topic of the presentation (course 1: presentation of around 30 min; executive summary of 5 pages; course 2: presentation of around 30 min; executive summary of around 3 pages).
The presentation is a means to measure the students' ability to understand the context and complexity of sustainable development in different countries and formal impact assessment procedures by preparing and delivering a well-researched and instructive oral presentation on a certain facet. An accompanying executive summary of major findings and conclusions indicates the capacity of the students to summarise the presentation in a clear and concise manner. In addition, the students are expected to show their oral communication skills by responding competently to questions and comments by the audience as well as by contributing to class discussions. Depending on the number of seminar participants, the presentation may be given either individually or in groups.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Class discussion is a core element of the seminars. Therefore, students are expected to take part and contribute to the discussions. Recommended Prerequisites: Module WZ2713 Methods of Scientific Communication.

Inhalt:
Course 1 "Sustainable Development and Regime Type": The seminar introduces both the theoretical debate on sustainable development and the discussion about the role political regime

type (democracy, autocracy, hybrid regime) play for the sustainability performance of a country. What are the goals of "sustainable development"? Which policy areas have a strong relationship to sustainability? To what extent do countries differ in their "sustainability profile" in various policy areas? What influence does the regime type play in this regard?
The seminar investigates these theoretical and empirical issues in the context of pressing future challenges, such as rising government debt in many countries, growing global competition for innovation, and intensifying global environmental degradation and resource scarcity. The seminar will focus on discussing theoretical approaches to current "sustainability debates" and considering what defines generationally just behavior. In addition, empirically based comparisons of countries under different political leadership will be made looking at several sustainability areas (e.g. economic, financial, educational, research, family, pension, environmental and energy policy).

Course 2 "Methods of Environmental Assessment": The seminar introduces the methodology of EIA and SEA as worldwide established instruments for assisting sound environmental management. Being integral parts of spatial planning and decision-making, the assessment procedures integrate biophysical and socioeconomic information to predict and evaluate the environmental consequences of proposed projects, plans and policies and to suggest means to avoid or mitigate significant impacts. The seminar gives an overview of the concepts, methods, procedural elements of EIA and SEA and stimulates discussion on key aspects of environmental assessment.

Lernergebnisse:
At the conclusion of the module, the students will have basic knowledge on sustainable development, its theoretical and empirical implications and its most important policy fields. The students understand the structure and the functioning of different political regimes and are able to evaluate their impact on the sustainable development of a country. Furthermore, the students are able to appreciate the purpose of EIA and SEA and their role in the decision-making process; explain the major principles and procedural steps of EIA and SEA; know options for estimating environmental impacts; reflect critically on the strength and limitations of the instruments; communicate findings in class and comment on the work of fellow students.

Lehr- und Lernmethoden:
In the SDRT seminar lectures, presentations and discussions provide students with a basic knowledge on sustainable development and political regime type and allows them to evaluate the performance of different states with regard to their sustainability performance.

In the MEA seminar, presentations by students and the lecturers provide the basis for exploring and discussing the concepts, methodology, current practice and potentials of environmental assessment. Class discussions engage students in critical thinking and analysing the scope and limitations of the presented material.

Medienform:
The module includes lectures, presentations, class discussions, (small group) exercises and assigned readings.

Literatur:
Wintrobe, R. (2000): The Political Economy of Dictatorship, Cambridge University Press, Cambridge; Tremmel, J. (2006): Handbook of intergenerational justice, Edward Elgar, Cheltenham; Glasson, J., Therivel, R. & A. Chadwick (2019): Introduction to Environmental Impact Assessment. 5th edition. Routledge, London and New York: 394 pages; Sadler, B., Aschemann, R., Dusik, J, Fischer, T.B., Partidário, M.R. & R. Verheem (2011): Handbook of Strategic Environmental Assessment. Earthscan, London, Washington, DC. Additional material will be provided.

Modulverantwortliche(r):
Augenstein, Isabel; Dr. agr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Methods of Environmental Assessment (Seminar, 2 SWS)
Augenstein I

(WZ2936) Sustainable Development and Regime Type (Seminar, 2 SWS)
Wurster S (Mohammed N, Schmid H)
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

BGU70005: Transportökonomie | Transportation Economics [Transportökonomie]

Modulbeschreibungsversion: Gültig ab Wintersemester 2017/18

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Die Prüfungsleistung ist eine Projektarbeit (Gruppenprojekt)
Im Rahmen der Projektarbeit wird anhand einer realistischen Aufgabenstellung aus dem Bereich der ökonomischen Bewertung von Verkehrssystemen (z.B. City-Maut, Infrastrukturinvestitionen, Sharing-Konzepte) überprüft, ob die Studierenden die Eignung der verschiedenen in der Vorlesung präsentierten Bewertungsmethoden für ihre Aufgabenstellung bewerten können und passende Methoden aussuchen können. Ferner zeigen sie, dass sie die ausgewählten Methoden auf das konkrete Beispiel richtig anwenden, quantitativ berechnen und die Ergebnisse zur Bewertung der Machbarkeit bzw. der Auswirkungen des Projekts verwenden können. Der Fortschritt des Projektes wird über eine Zwischenpräsentation geprüft. Am Ende wird die schriftliche Projektarbeit abgegeben, die zudem in einem Abschlussvortrag präsentiert wird. Die Note setzt sich wie folgt zusammen: Zwischenvortrag 15%, Abschlussvortrag 35%; schriftliche Projektarbeit 50%.

Wiederholungsmöglichkeit:
Semesterende

(Empfohlene) Voraussetzungen:
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Inhalt:
Das Moduls vermittelt den Studierenden einen Überblick über die Werkzeuge und Methoden, die zur Bewertung von Transportsystemen aus ökonomischer Sicht zur Verfügung stehen. Folgende Schlüsselbereiche werden abgedeckt:
• Einführung in die Transportökonomie
• Nachfrage und Angebot
• Gleichgewicht
• Externe Interaktionen

• Projektbeurteilung
• Transportinvestitionen
• Preisgestaltung
• Frachtökonomie
• Sharing-Ökonomie

Lernergebnisse:
Nach Abschluss des Moduls verstehen die Studierenden die methodischen Grundlagen zur ökonomischen Bewertung von Verkehrssystemen und Infrastrukturinvestitionen. Sie sind in der Lage, die wichtigsten wirtschaftlichen Aspekte aus dem Bereich der Transportsysteme, Investitionen und Maßnahmen zu bewerten und Aussagen über ihre wirtschaftliche Machbarkeit zu treffen. Des Weiteren sind die Studierenden in der Lage, eine Reihe von Kerntheorien der Verkehrsökonomie, wie der externen Kosten, der Grenzkosten, der Kosten/ Nutzen Betrachtungen, der Nachfrage-Versorgung Interaktionen und Elastizitäten auf praktische Aufgabenstellungen anzuwenden und die Ergebnisse dieser Anwendungen für reelle Transport-Projekte zu interpretieren und zu Empfehlungen auszuarbeiten.

Lehr- und Lernmethoden:
Format: Vorlesung mit integrieten Übungen;
In den Vorlesungen werden zunächst die theoretischen Grundlagen, beispielsweise der verschiedenen Modellbausteine zur ökonomischen Bewertung von Verkehrssystemen, ihre Einsatzmöglichkeiten- und Grenzen sowie ihre datentechnischen Voraussetzungen, unterstützt durch Bilder, ggf. Filme und Diskussionen vermittelt. Berechnungsbeispiele aus praxisnahen Untersuchungen und Modellen sowie die parallel laufende Bearbeitung einer Projektarbeit vermitteln die quantitativen Methoden zur Berechnung der verschiedenen Methoden und zur Interpretation der Berechnungsergebnisse in Hinblick auf Machbarkeit bzw. ökonomischer Wirkung von Projekten und Maßnahmen.

Medienform:
Präsentationsfolien, Whiteboard, Lesungen

Literatur:
Small, Kenneth. Urban transportation economics. Vol. 4. Taylor & Francis, 2013.
Button, Kenneth. Transport economics. Edward Elgar Publishing, 2010.
Gómez-Ibáñez, José A., William B. Tye, and Clifford Winston, eds. Essays in transportation economics and policy: a handbook in honor of John R. Meyer. Brookings Institution Press, 2011.

Modulverantwortliche(r):
Antoniou, Constantinos; Prof. Dr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Transportation Economics (Vorlesung mit integrierten Übungen, 4 SWS)
Antoniou C [L], Antoniou C, Ezzati Amini R, Rothfeld R

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

BGU38033: Urban Water-Energy-Food Nexus Planung | Planning the Urban Water-Energy-Food Nexus

Modulbeschreibungsversion: Gültig ab Sommersemester 2019

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 3	**Gesamtstunden:** 90	**Eigenstudiums-stunden:** 60	**Präsenzstunden:** 30

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Die Prüfungsleistung wird in Form einer Projektarbeit erbracht. Die Projektarbeit wird in kleinen Gruppen von Studierenden durchgeführt, wobei für jedes Gruppenmitglied ein individueller thematischer Schwerpunkt definiert wird. Ziel der Projektarbeit ist der Nachweis, dass die Grundlagen verschiedener technischer und nicht-technischer Komponenten eines integrierten städtebaulichen Ansatzes verstanden wurden und damit einfache städteplanerische Konzepte und Projekte entwickelt werden können. Die intensive Auseinandersetzung mit der Materie, die durch den Projektcharakter erforderlich ist, beweisen die Studierenden ein vertieftes Verständnis dieser Komponenten und die Fähigkeit, diese innovativ kombinieren zu können. Dieses Verständnis wird anhand von städteplanerischen, geografischen Informationssystems-, rechnerischen und modellierungs-Methoden nachgewiesen. Durch die Präsentation der Projektarbeit mit einer anschließenden kurzen Diskussion, zeigen die Studierenden ihre Fähigkeit, ihre entwickelten Konzepte, Ansätze und Methoden einem fachkundigen Publikum zu präsentieren und zu erklären.

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:
Water and Wastewater Treatment Engineering (BGU38014)

Inhalt:
In diesem Modul sollen Konzepte, Ansätze und Methoden für die integrierte Stadtplanung vermittelt werden. „Good Practice“ Beispiele werden zunächst allgemein diskutiert und anschließend bezogen auf die konkreten Anwendungen in einer Case Study Stadt besprochen. Das Modul umfasst zusätzlich die Konzepte und Hintergründe zu den Themen Verstädterung, Globalisierung, Klimawandel, Umweltherausforderungen, Nachhaltigkeitsziele wie UN

Sustainable Development Goals (SDGs) sowie Inhalte aus der aktuellen Forschung zur Wasserwiederverwendung.

Lernergebnisse:
Nach erfolgreicher Teilnahme an der Modulveranstaltung sind die Studierenden in der Lage:
• Die kontextuellen Herausforderungen und bestehende Konzepte, Ansätze und Methoden zu kennen und zu beschreiben
• Internationale Entwicklungsdynamiken des natürlichen Ressourcenkonsums zu verstehen und zu erklären
• Technische und nicht-technische Komponenten eines integrierten städtebaulichen Ansatzes auszuwählen und gegenüberzustellen
• Technische und nicht-technische Komponenten eines integrierten städtebaulichen Ansatzes situationsspezifisch zu beurteilen
• Innovative Konzepte und Kombinationen dieser Komponenten zu entwickeln

Lehr- und Lernmethoden:
Die Modulveranstaltung wird in Form einer Vorlesung mit Seminar Anteil angeboten. Die Inhalte werden in Form einer Vorlesung mit integrierter Diskussion vermittelt werden. Darüber hinaus werden gezielt Inhalte von den Studierenden in Gruppenarbeit erarbeitet. Zusätzliche Exkursionen dienen der Vertiefung und Diskussion der gelernten Inhalte.

Medienform:
Präsentationen, Gruppenarbeit

Literatur:
Hoff, H. (2011). Understanding the Nexus. Background Paper for the Bonn2011 Conference: The Water, Energy and Food Security Nexus. Stockholm Environment Institute, Stockholm, pp. 52.
Gondhalekar, D. and T. Ramsauer (2017). Nexus City: operationalizing the urban Water-Energy-Food Nexus for climate change adaptation in Munich, Germany. Urban Climate 19: 28–40, DOI: 10.1016/j.uclim.2016.11.004 [OA]

Modulverantwortliche(r):
Daphne Keilmann-Gondhalekar

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Urban Water-Energy-Food Nexus Planung (Vorlesung, 2 SWS)
Keilmann-Gondhalekar D [L], Keilmann-Gondhalekar D
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ0528: Urban Forestry | Urban Forestry

Modulbeschreibungsversion: Gültig ab Wintersemester 2018/19

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 60	**Präsenzstunden:** 90

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Die Modulprüfung besteht aus einer Klausur, in der die Studierenden Kenntnisse aus der Vorlesung zu Theorie und Methoden der Urbanen Forstwirtschaft und der begleitenden Projektübung ohne Hilfsmittel abrufen sollen. Die Beantwortung der Fragen erfordert kurze eigene Formulierungen und die Berechnung von Wuchs- und Ökosystemleistungen von Stadtbäumen, z.B.* mittels allometrischer Gleichungen.
Prüfungsdauer (min): 90. Darüber hinaus besteht die Möglichkeit über das Erstellen einer Projektarbeit über das Wachstum und die Ökosystemleistungen von Stadtbäumen als Studienleistung das Modul mit 6 CP abzuschließen.

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:

Inhalt:
Urbane Wälder sind definiert als der Gesamtbestand der Bäume in Städten und stadtnahen Gebieten. Urbane Forstwirtschaft ist ein Ansatz für ihre multifunktionale Planung, Gestaltung und das Management, um vielfältige ästhetische, ökologische, soziale und ökonomische Funktionen zu erfüllen. Ziel des Moduls ist es, den Teilnehmern dazu vertieftes Wissen und methodische Kenntnisse zu vermitteln. Das Modul besteht aus seiner Vorlesung und einem Studienprojekt. Die Vorlesungen umfassen folgende Inhalte:
• Theoretische Grundlagen und Aufgaben der Urbanen Forstwirtschaft
• Gestaltung urbaner Wälder
• Multifunktionales Management urbaner Wälder
• Ökophysiologie von Stadtbäumen
• Baumwachstum und -struktur

• Verbesserung des Stadtklimas durch Stadtwälder und -bäume
• Phänologie von Stadtbäumen
• Modellierung des Wachtsums und der Ökosystemleistungen von Stadtwäldern und -bäumen
• Artenwahl für städtische Pflanzungen

Die Teilnehmer untersuchen in einem Studienprojekt das Wachstum von Stadtbäumen und deren Ökosystemleistungen, um ein vertieftes Verständnis der Wachstumsmuster und Leistungen von Stadtbaumarten in Abhängigkeit von den vorherrschenden Wuchsbedingungen zu erhalten.

Lernergebnisse:
Nach der Teilnahme an der Modulveranstaltung sind die Studierenden in der Lage, (i) wichtige theoretischen Grundlagen der urbanen Forstwirtschaft zu verstehen und sie in der Praxis anzuwenden, (ii), die klimatischen Funktionen von urbanen Wäldern und Bäumen zu analysieren, (iii) Methoden für die Analyse von urbanen Wäldern anzuwenden, (iv) Ökosystemleistungen von urbanen Wäldern zu erfassen und zu bewerten (v) diese Kenntnisse in einem selbstständigen Studienproject anzuwenden. Im Studienprojekt sollen die Studierenden zeigen, dass sie in der Lage sind, eine Methodik zur Erfassung und Analyse wichtiger Parameter des Wachstums von Stadtbäumen richtig anzuwenden, um unter Bezug auf die relevante wissenschatliche Literatur hieraus Ökosystemleistungen der Bäume (etwa Kohlenstoffspeicherung, Verschattung) zu ermitteln und Schlussfolgerungen für das Management urbaner Bäume zu ziehen.

Lehr- und Lernmethoden:

Medienform:

Literatur:

Modulverantwortliche(r):
Stephan Pauleit, Thomas Rötzer

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Urban Forestry (Vorlesung mit integrierter Übung) (Vorlesung, 4 SWS)
Lupp G, Pauleit S, Pretzsch H, Rahman M, Reischl A, Rötzer T, Torano Caicoya A
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ1344: Urban Agriculture | Urban Agriculture

Modulbeschreibungsversion: Gültig ab Wintersemester 2020/21

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The module grade is based on a written report (approx. 20 pages; 80% of grade) complemented by a group oral presentation (15 min. + 5 min. discussion; 20% of grade). In the report, the students design a strategy for ecologically-oriented sustainable urban agriculture. Here, students should situate their strategy in a theoretical framework, and evaluate the relevant ecological and social context of their strategy. Written summaries measure the student's understanding and evaluation of ecological and social aspects, and ability to apply theoretical frameworks. In the presentation, the students collectively present their strategy (PowerPoint plus any additional aides) to demonstrate understanding of an urban agriculture system, communicative competence, presentation and discussion skills in front of an audience.

Wiederholungsmöglichkeit:
Folgesemester / Semesterende

(Empfohlene) Voraussetzungen:
Basic knowledge in ecology, agriculture, landscape ecology is an advantage

Inhalt:
Urban agriculture has experienced a renaissance in recent decades. What are the possibilities for sustainable urban agriculture that supports multiple ecosystem services? This module explores ways in which urban agriculture can aid in the enhancement of food security, biodiversity, energy conservation, public health and well-being in cities. We will discuss the agro-ecological basis of urban horticultural production systems adapted for city environments. Topics include fundamentals of horticulture, soil properties and fertility, pest and pollinator management, animal agriculture, and climate change impacts. The students will learn about methods of urban agriculture and innovative approaches to ecologically-oriented and climate-resilient urban agriculture. In addition, they will study how urban food production interacts with social, cultural, and political dimensions

of urban environments (e.g. city policy, economics, human health) to foster an interdisciplinary understanding.

Lernergebnisse:
On successful completion of the module, participants are able to:
1. understand important ecological aspects of urban agriculture such as biodiversity, soil management and climate mitigation;
2. relate social aspects of urban agriculture to ecological aspects such as public health and urban policy;
3. apply ecological theoretical frameworks to urban agricultural systems;
4. evaluate the ecological and social context of urban agriculture;
5. create a strategy for a sustainable urban agricultural system in a project;
6. communicate their strategy with understanding and evidence.

Lehr- und Lernmethoden:
The module is highly interactive and combines lectures with field trips and presentations from guests and peers. The lecture series will cover topics including: fundamentals of horticulture; soil management; pest and pollinator management; urban agriculture and climate change; challenges of urban agriculture; public health; and the business of urban agriculture. The seminars are based in experiential learning. In the seminars, we will 'see' cities as edible: in the present on field trips; in the past through films and advanced readings; and in the future through group presentations that design urban farming systems for future cities.

Medienform:
PowerPoint, films, virtual lectures

Literatur:

Modulverantwortliche(r):
Egerer, Monika; Prof. Dr.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Edible Cities (Seminar, 2 SWS)
Egerer M

Urban Agriculture (Vorlesung, 2 SWS)
Egerer M [L], Egerer M
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2723: Utilization and Treatment of Special Materials and Waste | Utilization and Treatment of Special Materials and Waste

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 30

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The learning outcome will be assessed by presentation. The presentation will be complemented by a brief written precis. This assessment method is a good means to evaluate both whether the students are able to work self-reliantly on a topic and to present their significant results to an auditorium and whether they have understood their respective selected topic.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in natural science (biology, chemistry, ecology, physics) and engineering.

Inhalt:
The students acquire detailed and differentiated knowledge about the following topics:

- Selected materials, products and production processes concerning high waste generation and heavy environmental problems
- Origin and types of the specific wastes,
- Classical disposal,
- Waste as a source of raw material,
- Utilization for products,
- Energetic utilization,
- Legal specification.

The special topics addressed depend on relevance, e.g. food and food waste, sewage sludge, e-waste or the like.

Lernergebnisse:
By the means of the module the students are able:

- to describe the differences of special waste, e.g. food waste and selected municipal or industrial waste,
- to classify the amount and quality of special waste streams,
- to analyze problems concerning the special wastes,
- to develop treatment measures to handle the waste for avoiding or reducing impacts on the environment and human health,
- to transmit developed solutions to other waste and new products.

Lehr- und Lernmethoden:
The module consists of a lecture, providing the theoretical foundations, in combination with a seminar including feedback by the lecturers to the students' work. The students have to define and to solve problems collaboratively in group work by studying specialist literature. At the end they have to prepare a presentation and a brief summary including problem statement and conclusions as homework under time constraint about this topic. The students are supervised by the lecturers.

Medienform:
PowerPoint Presentation

Literatur:
Oreopoulou V.; Russ W. (2007): Utilization of By-Products and Treatment of Waste in the Food Industry, Springer; New York.
Additional literature depending on themes.

Modulverantwortliche(r):
Prof. Dr. Gabriele Weber-Blaschke - Lehrstuhl für Holzwissenschaft Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising; 08161/71- 5635; weber-blaschke@hfm.tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Utilization and Treatment of Special Materials and Waste (Seminar, 2 SWS)
Weber-Blaschke G [L], Reh K
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

LS10006: Vertical Farming | Vertical Farming

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Die Prüfungsleistung wird in Form einer Projektarbeit erbracht. Sie besteht aus einem schriftlichen Bericht (ca. 15 Seiten; 60% der Note), ergänzt durch zwei mündliche Gruppenpräsentation ((i) 60 min., 20% der Note; (ii) 15 min. + 10 min. Diskussion, 20% der Note). In der abschließenden schriftlichen Arbeit präsentieren die Studierenden ihren Entwurf für ein Konzept für ein Vertical Farming Indoor System auf dem Campus Weihenstephan. Die Studierenden weisen darin außerdem nach, dass sie die Aspekte der Vertikale Farming hinsichtlich Ihrer konkreten Anwendung in der Versuchsstation (Lab) vor Ort bewerten können. In der Präsentation (PowerPoint und zusätzliche Hilfsmittel) stellen die Studierenden gemeinsam eine (i) Analyse zur vertikale Anbausysteme, Hydrokulturen, Aquaponik und damit verbundene Technologien vor, und (ii) Strategie vor, um das Vertical Farming-System erklärt, ihre kommunikative Kompetenz sowie ihre Präsentations- und Diskussionsfähigkeiten vor einem Publikum zu demonstrieren.

Wiederholungsmöglichkeit:
Semesterende

(Empfohlene) Voraussetzungen:
Grundkenntnisse in den Bereichen Technik, Landwirtschaft und Informatik sind von Vorteil.

Inhalt:
Im Mittelpunkt des Moduls steht das Vertical Farming, das zur Verbesserung der nachhaltigen Lebensmittelproduktion, des Ressourcenmanagements und der Energieeinsparung in Städten beitragen kann. Die Grundlagen der Produktionssysteme des Vertical Farming werden erörtert und an die städtischen Bedingungen angepasst. Konzeptentwicklung und Design von Vertical Farming-Systemen (Hydroponik und Aquaponik), elektrische und künstliche Intelligenz, Pflanzen- und Schädlingsbekämpfung sind die Kernthemen des Moduls. Die Studierenden lernen Methoden und innovative Ansätze für Vertical-Farming-Systeme kennen und werden im Rahmen der Sustainable-Living-Lab-Initiative ein Konzept für ein Vertical Farming indoor system entwickeln. Das System mit

integrierter Beleuchtung wird als Prototyp dienen und 365 Tage im Jahr Lebensmittel produzieren können.
Das Modul bietet einen Rahmen für strukturierte Diskussionen rund um das Thema Nachhaltigkeit und nachhaltige Lebensmittelsysteme im urbanen Raum und zeigt praktische Umsetzungsmöglichkeiten auf. Auch beim Bau und der Energieversorgung wird die Nachhaltigkeit berücksichtigt. Entscheidend für die erfolgreiche Umsetzung des Konzepts ist die interdisziplinäre Zusammenarbeit zwischen verschiedenen Fachrichtungen.

Lernergebnisse:
Nach erfolgreichem Abschluss des Moduls sind die Teilnehmer in der Lage:
1. die Vorteile und Nachteile von vertikalen Anbausystemen und ihre Rolle in nachhaltigen Lebensmittelsystemen zu analysieren
2. die Grundlagen von hydroponischen und aquaponischen Systemen zu verstehen;
3. ein Konzept für ein Vertical Farming-Indoor-System für das Sustainable-Living-Lab auf dem Campus Weihenstephan zu erstellen, das Elektrotechnik, künstliche Intelligenz und Architektur integriert;
4. eine Strategie für das Pflanzenmanagement und das Management des VF-Systems zu entwickeln;
5. ihr VF-Konzept und -Design verständlich und nachvollziehbar zu kommunizieren.

Lehr- und Lernmethoden:
Das Modul wird aus einem Projekt (PT) bestehen, bei dem die Studenten ein Vertical Farming-System entwerfen.
Das Module ist ein interaktives, praxisbezogenes und interdisziplinäres Lehrformat, das auf experimentellem Lernen basiert und großen Wert auf Gruppenarbeit und Diskussionen im „Flipped Classroom-Design“ legt. In dieser Hinsicht handelt es sich um ein Projekt, da die Studierenden ihr eigenes Konzept entwerfen werden. Gastvorträge und grundlegende Informationen zu vertikalen Anbausystemen, Schädlingsbekämpfung, Hydrokulturen, Herausforderungen der städtischen Landwirtschaft sowie öffentliche Gesundheit und Bewusstsein sollen die Studierenden zusätzlich unterstützen. Darüber hinaus haben die Studierenden die Möglichkeit, die Vorlesungsreihe des der Lehrveranstaltung Urbane Landwirtschaft zu besuchen. Die Teilnehmer in Gruppen erhalten Zugang zur High-Tech Werkstatt Makerspace und ein Startbudget, um ihr eigenes Konzept zu entwickeln.
Am Modul können Studierende aller Fakultäten teilnehmen. Das Projekt wird in Englisch angeboten, sodass auch internationale Studierende integriert werden können.

Medienform:
Präsentationen, wissenschaftliche Artikel, Gruppendiskussionen, Poster.

Literatur:
keine Angabe

Modulverantwortliche(r):
Egerer, Monika, Prof. Dr. monika.egerer@tum.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Project Vertical Farming (Projekt, 4 SWS)
Egerer M [L], Egerer M
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4201: Vegetation Ecology and Geographical Information Systems | Vegetation Ecology and Geographical Information Systems

Modulbeschreibungsversion: Gültig ab Sommersemester 2021

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Aufgrund des Pandemiegeschehens wird die alternative Prüfungsform unbeaufsichtigte elektronische Fernprüfung
(90 min. Moodle-Upload, Online-Prüfung: WZ4201o) angeboten.

A written exam of 90 minutes assesses whether the students understand the basic concepts of spatial data analysis as well as vegetation ecology with respect to manage landscapes, the students' ability to apply these techniques to certain problems in landscape management as well as the students' ability to precisely describe solutions to achieve certain results within a limited amount of time.
A Mid-Term assignment (presentation) assesses the students' ability to communicate management plans based on vegetation and habitat data. It will serve for grade improvement by 0,3 according to §6 (5) APSO.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Basic knowledge in GIS, remote sensing, for example learned by attending the module "Inventory Methods, Statistics and GIS".
Basic knowledge of population biology, community and ecosystem ecology.

Inhalt:
GIS:
1. Advanced analysis and visualization of spatial data
2. GIS based raster analysis
3. GIS and satellite navigation
4. Application of GIS in selected projects
5. Introduction to the vegetation ecology, theory of plant distribution and of plant communities
6. Methods of habitat mapping
7. Habitat mapping in the field
8. Field data analysis
9. Management measures for management plans

Vegetation Ecology:
1. Vegetation ecology: overview, historical notes and outline;
2. Vegetation and the environment: classification of natural & semi-natural vegetation;
3. Clonality in plant communities & seed ecology and assembly rules in plant communities;
4. Species interactions structuring plant communities;
5. Vegetation and the ecosystem & vegetation dynamics;
6. Plant functional types and traits & diversity and ecosystem function;
7. Vegetation conservation, management and restoration;
8. Plant invasions and invasibility of plant communities;
9. Vegetation mapping: vegetation types and scales, from landscape to regional;
10. Practical aspects of vegetation sampling and classification.

Lernergebnisse:
At the end of the module students are able to:
• Manage, analyze and visualize spatial data to solve problems related to landscape management
• Break down general problems in landscape management to tasks which can be solved by using a GIS
• Develop and communicate management plans based on vegetation and habitat data
• Ascertain and classify habitats
• Understand the basic principles for the study of plant communities
• Identify vegetation types and describe its main aspects
• Apply different methods of vegetation sampling and classification

Lehr- und Lernmethoden:
Theoretical explanation of certain topics followed by practical exercises using GIS software supported by screen animations.
Transfer of theoretical knowledge in lectures (vegetation ecology, habitat mapping), practical fieldwork and presentation of proposals for landscape management measures.

Introduction of theoretical and methodological aspects related to vegetation ecology studies, classification of vegetation types and practical aspects regarding the discipline.

Medienform:
GIS Software, PowerPoint Presentations, Instruction videos.

Literatur:
Vegetation Ecology, 2nd edition (Edited by Eddy van der Maarel & Janet Franklin)
Vegetation Ecology of Central Europe, vol. I and II (by Christoph Leuschner & Heinz Ellenberg)
Global Vegetation – Fundamentals, Ecology and Distribution (by Jörg S. Pfadenhauer & Frank A. Klötzli)
The Ecology of Plants (by Jessica Gurevitch)
Vegetation Description and Data Analysis – A Practical Approach, 2nd edition (by Martin Kent)
From Plant Traits to Vegetation Structure – Chance and selection in the assembly of ecological communities (by Bill Shipley)
Data Analysis in Vegetation Ecology, 3rd edition (by Otto Wildi)

Modulverantwortliche(r):
Döllerer, Martin; Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
GIS (Landscape Management) (Vorlesung mit integrierten Übungen, 2 SWS)
Döllerer M

Vegetation Ecology (Vorlesung, 2 SWS)
Teixeira Pinto L
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ0322: Ökologisches Kolloquium: Wissenschaftliche Grundlagen und Anwendungen in der Praxis | Ecological Colloquium: Scientific Foundations and Applications in Practice [WissReisen]

Modulbeschreibungsversion: Gültig ab Wintersemester 2021/22

Modulniveau: Master	**Sprache:** Deutsch/Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 105	**Präsenzstunden:** 45

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Die Modulprüfung besteht aus einem Bericht (ca. 10 S., 75 % der Note) und wird durch eine Präsentation mit Diskussion ergänzt (ca. 20 min., 25 % Note). Mit dem Bericht weisen die Studierenden nach, dass sie Fachwissen zu Ökologie, Naturschutz, Biodiversität, Nachhaltigkeit der Ressourcennutzung und Landschaftsplanung schriftlich kommunizieren können. Anhand der Präsentation demonstrieren die Studierenden, dass sie selbstständig zu Wissenschaftler*innen recherchieren und deren Ergebnisse professionell präsentieren können. Die Studierenden sollen zudem zeigen, dass sie aktuelle Probleme und Forschungsfragen sowie transdisziplinäre Zusammenhänge zwischen Forschung, Planung, Natur- und Umweltschutz, Politik und Gesellschaft in diesem Fachgebiet bewerten können.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Je nach Thema Grundkenntnisse in Landschafts-, Vegetations-, Tier-, Wald- oder Bodenökologie, in Klimatologie und in Landnutzung notwendig,

Inhalt:
Das Modul besteht aus einem Seminar und einer Übung. Grundlage des Moduls ist eine Reihe von Gastvorträgen von international oder national ausgewiesenen Expert*innen, die ausgewählte Themen der Ökologie, des Naturschutzes, der Biodiversitäts- und Nachhaltigkeitsforschung sowie Landschaftsplanung vorstellen. Die Studierenden bereiten sich durch Lektüre der Publikationen der Gäste und fachverwandter Untersuchungen auf den Vortrag vor. Im Rahmen der Übung stellen

sie den jeweiligen Gast und das Thema vor und diskutieren die Vorträge im Vergleich mit anderen Beiträgen.
Außerdem dokumentieren sie, wie die fachlichen Inhalte aufbereitet und präsentiert werden. Aufbauend auf Publikationen zu den Vortragsthemen und Präsentationen analysieren die Studierenden, mit welchen Methoden und Techniken die Wissenschaftler*innen ihre fachlichen Inhalte vermitteln. Dies geschieht in einer schriftlichen Ausarbeitung, welche am Ende des Seminars erstellt wird.

Lernergebnisse:
Nach erfolgreichem Abschluss des Moduls sind die Studierenden in der Lage,
• wissenschaftliches Fachwissen zu aktuellen Themen im Bereich Ökologie, Naturschutz, nachhaltige Ressourcenproduktion und -nutzung sowie Landschaftsplanung zu verstehen;
• die Qualität von Fachvorträgen von (inter)national ausgewiesenen Expert*innen zu ausgewählten Themen der Ökologie, des Naturschutzes, der Biodiversitäts- und Nachhaltigkeitsforschung sowie Landschaftsplanung nach Methoden und Techniken, Inhalt und Form zu bewerten;
• zur Biographie und den fachlichen Schwerpunkten von Wissenschaftler*innen zu recherchieren; und
• die Ergebnisse ihrer Analyse und Recherche effizient und angemessen in einem schriftlichen Bericht darzulegen, in einer Präsentation vorzustellen und kritisch zu diskutieren.
Die Studierenden können damit wesentliche Probleme und Forschungsfragen sowie transdisziplinäre Zusammenhänge zwischen Forschung, Planung und Bewirtschaftung, Natur- und Umweltschutz, Politik und Gesellschaft kritisch bewerten.

Lehr- und Lernmethoden:
Die Studierenden bereiten sich durch Lektüre der Publikationen der Gastwissenschaftler*innen und fachverwandter Untersuchungen auf die jeweiligen Vorträge vor. In der schriftlichen Ausarbeitung dokumentieren sie, wie die fachlichen Inhalte und andere wissenschaftliche Themen aufbereitet und diskutiert werden. Aufbauend auf dem Lebenslauf und den Publikationen der Gäste und den Vorträgen analysieren die Studierenden, mit welchen Methoden und Techniken die Wissenschaftler*innen ihre fachlichen Inhalte vermitteln. Durch die kritische Analyse von Publikationen und Fachvorträgen lernen die Studierenden, wie Wissenschaftler*innen ihre Ergebnisse in der Öffentlichkeit kommunizieren. Durch Vergleich und Diskussion mehrerer Gastvorträge im Rahmen der Übung erlernen die Studierenden die wesentlichen Techniken, Fachwissen effizient in Wort und Schrift zu vermitteln. Die Kombination aus mündlicher Präsentation und schriftlichem Bericht entspricht dem Anforderungsprofil von Studienabsolventen*innen in den Berufsfeldern Ökosystemmanagement, Naturschutz, Landschaftsplanung und Öffentlichkeitsarbeit.

Medienform:
Seminar: PowerPoint-Präsentationen, Skript; Übung: Wissenschaftliche Originalartikel, eigene Präsentationen der Studierenden.

Literatur:
Ascheron, C. (2007) Die Kunst des wissenschaftlichen Präsentierens und Publizierens: ein Praxisleitfaden für junge Wissenschaftler. Elsevier, Spektrum Akademischer Verlag.
Themenspezifische Literatur zum Seminar wird zur jeweiligen Veranstaltung bekannt gegeben.

Modulverantwortliche(r):
Leonhardt, Sara Diana; Prof. Dr. rer. nat.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Forum Naturschutz (Übung, 2 SWS)
Kollmann J

Weihenstephaner Kolloquium zur Angewandten Ökologie und Planung (Kolloquium, 2 SWS)
Kollmann J, Häberle K, Annighöfer P, Egerer M, Geist J, Grams T, Kögel-Knabner I, Leonhardt S, Menzel A, Pauleit S, Pretzsch H, Rammig A, Rötzer T, Schäfer H, Seidl R, Tellier A

Seminar Angewandte Ökologie und Planung (Seminar, 2 SWS)
Kollmann J, Häberle K, Annighöfer P, Egerer M, Geist J, Grams T, Schäfer H, Kögel-Knabner I, Leonhardt S, Menzel A, Pauleit S, Pretzsch H, Rammig A, Rötzer T, Seidl R, Tellier A

Wissenschaftl. Reisen: von Beobachtungen und Grundlagen zur angewandten Forschung (Seminar, 2 SWS)
Leonhardt S [L], Annighöfer P, Egerer M, Leonhardt S

Wissenschaftl. Reisen: von Beobachtungen und Grundlagen zur angewandten Forschung (Übung, 1 SWS)
Leonhardt S [L], Annighöfer P, Egerer M, Leonhardt S
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ2735: World Soil Resources | World Soil Resources

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 80	**Präsenzstunden:** 70

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
In an oral exam of 30 minutes duration, students demonstrate in a scientific discussion by answering questions without helping material their fundamental understanding of the soils of the world in relation to other ecological factors, and they remember the soils of the field course as well as the methods of surveying and classifying soils in the field. In a pass/fail exam (laboratory assignment) in the field of 10 minutes duration, they prove their ability to survey and classify soils of various landscapes and environmental settings. The understanding of soils, as achieved in the module "Introduction to soil science" is implicitly part of the oral exam.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
The successful participation at the module "Introduction to Soil Science" (which is given in the first half of the summer semester) is required.

Inhalt:
• Soils of the world
• Chemical, biological and physical properties of soils
• Genesis of soils as the result of soil-forming processes
• Soil survey
• Soil classification according to the international system
• Soil interpretation.

Lernergebnisse:
The students are able to apply their knowledge of soils, as achieved in the module “Introduction to Soil Science”, to all soils of the world. The students understand the characteristics of the soils of the world, the pattern of their geographical distribution, their genesis, their ecological potential and

the threats to their functions. The students are able to survey a soil profile, to detect the genesis of the surveyed soil and to classify it according to the international soil classification system. They are able to evaluate the possibilities and risks of soil management. They can assess the relationship between the soil and its environmental setting.

Lehr- und Lernmethoden:
The lecture gives an overview of all soils of the world. The field course (several days) presents soils in a landscape outside southern Bavaria. The students are trained in the methodological skills of soil survey, soil classification and soil interpretation.

Medienform:
Lecture: presentation notes. Field Assessment: spade, auger, knife, colour charts.

Literatur:
FAO Guidelines for Soil Description. Prepared by Jahn, Blume, Asio, Spaargaren, Schad, 2006.
IUSS Working Group WRB: World Reference Base for Soil Resources 2014. Update 2015. Prepared by Schad, van Huyssteen, Micheli. FAO World Soil Resources Reports 106.

Modulverantwortliche(r):
Schad, Peter; Dr. rer. silv.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
World Soil Resources: Lecture (Vorlesung, 2 SWS)
Schad P

Bodenansprache und Bodenklassifikation nach internationalen Standards (Übung, 2,8 SWS)
Schad P
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4198: Wildlife Management and Wildlife-Human Interactions | Wildlife Management and Wildlife-Human Interactions

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Written assignment (ca. 15 pages) requiring review of literature, synthesis and integration of key concepts and findings from the literature to develop a coherent research proposal that clearly demonstrates knowledge in the field of species management and conservation strategies and of human dimensions as a research and applied field of study. Expected to read in advance where possible assigned readings so to be prepared for course lectures.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
This lecture combines contents of Wildlife Management and Wildlife Human Interactions. The key aspects are: 1) Principles of Wildlife Management & Wildlife Science, 2) Planning tools, 3) Case study: Strategic planning, 4) Conflicting views in WMT with case studies, 5) Basic Concepts in Ecology, 6) Reintroductions studies, 7) Global threats to Conservation, 8) Nature of human dimensions (HD) from a research perspective through various examples 9) Nature of various wildlife-human interactions from different perspectives, 10) Nature of public involvement and HD as an applied approach 11) Types of conflict, levels of planning and how to work with people toward solutions, 12) Understanding decision-making processes.

Lernergebnisse:
After the course students are able to: understand important ecological concepts in wildlife management; understand the importance of the human dimension in wildlife management; analyze a conservation strategy for a species; apply wildlife management plans; evaluate species

and protected area management plans; understand the importance and nature of objectivity in conducting research and being a human dimension researcher; develop the ability to synthesize relevant literature pertinent to a research problem; organize ideas effectively and communicate these in a well-organized and developed written proposal.

Lehr- und Lernmethoden:
Lecture, video, group exercises, discussions

Medienform:
lecture notes, flip-chart/board, hand-outs, additional reading material

Literatur:
Sinclair et al. 2006, Wildlife Ecology, Conservation, and Management, ISBN 1-4051-0737-5 ; Krausman 2002, Wildlife Management, ISBN 0-1328-0850-1; Pullin 2002, Conservation Biology, ISBN 0-521-64482-8

Modulverantwortliche(r):
Kühn, Ralph; Apl. Prof. Dr. agr. habil.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Wildlife-Human Interactions (Seminar, 2 SWS)
Kühn R [L], Bath A

Wildlife Management (Vorlesung, 2 SWS)
Kühn R [L], Rödl T
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ4207: Waste and Waste Water Treatment | Waste and Waste Water Treatment

Modulbeschreibungsversion: Gültig ab Wintersemester 2020/21

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 90	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The written exam (90 min.) consists of general questions and simple calculations. In the written exam students demonstrate their theoretical knowledge of waste and wastewater treatment. The answers require wording but also single choice tests as well as calculations. Only the use of a calculator is allowed (closed book exam).

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Interest and basic knowledge in chemistry, physics, biology and preferably in environmental, chemical, civil or process engineering. However, the level of the course is adapted to the known broad spectrum of background knowledge allowing also students to follow you hold a bachelor in a totally different realm.

Inhalt:
Waste management:

1. Basics of waste management (What is waste, waste amounts, history and future of waste, waste legislation);
2. Avoidance and recovery of waste and waste management concepts;
3. Waste disposal (legal aspects of landfill, processes in above-ground landfill, above-ground landfill technologies, underground disposal sites);
4. Biological treatment (legal aspects, composting, fermentation, mechanical biological treatment, sewage sludge,
substitute fuels);

5. Thermal treatment (legal aspect, thermal processes, equipment, power generation, alternative thermal processes, hazardous waste treatment).

Wastewater treatment:

1.Water treatment & management concepts; overview wastewater treatment steps
2. Wastewater characteristics & discharge limits
3. Mechanical wastewater treatment
4. Fundamentals in bioprocess technology; stoichiometry of biological reactions; kinetics of biological reactions; aeration
5. Biological wastewater treatment
6. Sewage sludge treatment
7. Field trip Garching wastewater treatment plant (optional)

Lernergebnisse:
At the end of the module, students are able to:

1. Understand the necessity and objectives of waste management.
2. Understand the most important processes and technologies for waste treatment.
3. Decide which treatment method is valid for which type of waste.
4. Understand sources and types of emissions arising from waste treatment and measures for emission reduction

8. Understand the necessity and the feasibility of wastewater treatment especially in treating municipal wastewater.
9. Classify the single steps of eliminating wastewater compounds, such as coarse material, organic and inorganic pollutants.
10. Recall important treatment processes and their requirements.
11. Asses pros and cons of different treatment technologies.

Lehr- und Lernmethoden:
The knowledge in the field of waste management is imparted during lectures. Theoretical background is given and discussed at practical examples of existing waste management infrastructure (Collection Systems, Landfills, Treatment Facilities, etc.)

The content of the lecture are taught through practical examples. By means of example tasks in the lecture, possible solutions are discussed and exemplified calculations are performed. An optional field trip to the Garching wastewater treatment plant at the end of the course allows connecting theoretical knowledge with practical application and gives a final platform for questions.

Medienform:
The course is mainly taught by PowerPoint presentation and supported by notices on the black board. The lecture notes are uploaded to Moodle. It is ensured that further readings are available in the university library either for download or as hardcopy in an adequate number.

Literatur:
Waste Management:
Bilitewski, B., Härdtle, G., Marek, K.; Weissbach, A.; Boedekker, A.: Waste Management, Springer-Verlag Berlin Heidelberg, ISBN-10: 9783642082122

Waste Management: https://issuu.com/tkverlag/docs/waste_management_4
Evans, G. (Ed): Biowaste and Biological Waste Treatment, ISBN: 978-1-902916-08-8

Wastewater Treatment:
la Cour Jansen, J., Arvin, E., Henze, M., Harremoes, P., 2019. Wastewater treatment - Biological and chemical Processes. Polyteknisk Boghandel og Forlag, Lyngby.
Tchobanoglous, G., Burton, F.L., Tsuchihashi, R., Stensel, H.D., 2013. Wastewater Engineering: Treatment and Resource Recovery. McGraw-Hill, Boston.
Wiechmann, B., Dienemann, C., Kabbe, C., Brandt, S., Vogel, I., Roskosch, A., 2013. Sewage sludge management in Germany. Umweltbundesamt, Bonn.

Modulverantwortliche(r):
Konrad Koch

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Waste Management (Vorlesung, 2 SWS)
Franke M

Waste Water Treatment (Vorlesung, 2 SWS)
Koch K
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

WZ6432: Wildlife and Conservation Biology | Wildlife and Conservation Biology

Modulbeschreibungsversion: Gültig ab Sommersemester 2020

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Sommersemester
Credits:* 5	**Gesamtstunden:** 150	**Eigenstudiums-stunden:** 75	**Präsenzstunden:** 75

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The examination consists of an oral examination (30 min). The examination means to measure the student's ability to assess anthropogenic influence on Biodiversty, to explain factors affecting Wildlife, to recall methods in Conservation Biology and applied Genetics and to evaluate Conservation Biology concepts. In the written examination students demonstrate by answering questions under time pressure and without helping material their theoretical and practical knowledge about Wildlife and Conservation Biology. For answering the questions, the students require their own wording. In the practical excercise the students present a case study and design a own research project proposal to practice their scientific communication skills and to transfer the theoretical knowledge to practical projects.

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
Interest in Wildlife Conservation Biology and Nature Conservation. Basic background in Biology

Inhalt:
The module combines the theoretical background and the practical implementation of Wildlife Conservation Biology, Conservation Genetics and Nature Conservation. The key aspects are:
1. Scope and tasks of Conservation Biology and applied Genetics
2. Biodiversity, Ecosystems, Ecosystem Services and Green Bankiing
3. Factors affecting terrestrial and aquatic Biodiversty
4. Methods in Wildlife Conservation Biology and applied Genetics 5. Conservation Biology concepts and strategies for natural population using international examples
6. Case studies and applied Nature Conservation, from theory to praxis

Lernergebnisse:
At the end of the module students understand the importance of Biodiverstiy of terrestial resources and its interaction with human dimensions. They are able to apply and to evaluate Conservation Biology methods and strategies based upon an interdisciplinary understanding of species biology, conservation biology and applied genetics. In addition, students are able to integrate interdisciplinary knowledge into applied conservation management on a regional and international scale. They have an overview of applied interdisciplinary Nature Conservation management and are able to evaluate sustainable resource management strategies.

Lehr- und Lernmethoden:
The module combines the lecture "Wildlife and Conservation Biology" with an accompanying practical excercise " Case Studies in Nature Conservation". The lecture contents will be presented using lectures based on power-point presentation and group work in order to combine activating teaching methods with classic presentation techniques. In the accompanying practical excercise, the students will apply the gained theoretical knowledge by conducting case studies (research programs), and presenting own concepts of research project in various content in the field of Wildlife Conservation Biology and Nature Conservation. Here the students learn to independently screen the respective literature in this field and learn methods in science communication.

Medienform:
Form of presentation: lecture, case study, movie segment and practical excercise
material: lecture notes, flip-chart/board, plus different materials for methodological/technical training

Literatur:
1. Primack (2014) Essentials of Conservation Biology 2. Frankham (2010) Introduction to Conservation Genetics 3. Sutherland (2009) Conservation Science and Action

Modulverantwortliche(r):
Kühn, Ralph; Apl. Prof. Dr. agr. habil.

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Conservation Biology and Applied Genetics (Vorlesung, 2 SWS)
Kühn R

Case Studies in Nature Conservation (Übung, 3 SWS)
Kühn R, Stoeckle B
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Studienleistungen | Course Achievement

Modulbeschreibung

WZ4061: Internship | Internship

Modulbeschreibungsversion: Gültig ab Sommersemester 2015

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:**	**Häufigkeit:** Wintersemester
Credits:* 10	**Gesamtstunden:** 300	**Eigenstudiums-stunden:** 300	**Präsenzstunden:** 0

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
Nach Abschluss des Praktikums muss der Student einen Praktikumsbericht und ein Bestätigungsschreiben des Praktikumsgebers einreichen, in dem der Arbeitgeber die Dauer des Praktikums mit eventuellen Fehlzeiten und die Art der Arbeit, die vom Praktikanten geleistet wurde, spezifiziert.

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:
Keine

Inhalt:
Gemäß den Studienregeln für den Masterstudiengang "Nachhaltiges Ressourcenmanagement" muss jeder Studierende ein Praktikum außerhalb seines Heimatlandes mit einer Mindestdauer von 7 Wochen (10 ECTS-Credits) absolvieren. Das Praktikum sollte den Auszubildenden ermöglichen, Einblicke in die verschiedenen Tätigkeitsbereiche für nachhaltiges Ressourcenmanagement zu erhalten.
Der Student sollte in die Lage versetzt werden, seine individuellen Karrierewünsche auszuloten und potenzielle Arbeitgeber zu kontaktieren.
Der Student muss selbst nach einem Praktikum suchen und es so planen, dass es nicht in Konflikt mit den Vorlesungszeiten steht. Eine empfohlene Zeitspanne für das Praktikum liegt zwischen dem zweiten und dritten Semester (August-Oktober).
Das Praktikum kann in zwei Teile mit einer Mindestdauer von jeweils einem Monat aufgeteilt werden.

Aus wichtigen Gründen sind weitere Aufteilungen möglich, müssen aber vorab durch das Praktikantenamt genehmigt werden.
Es ist möglich, das Praktikum in verschiedenen Organisationen zu absolvieren; die Mindestdauer von einem Monat ist aber einzuhalten.
Das Praktikum muss außerhalb einer Universität stattfinden. Empfohlen werden Organisationen, die als potentielle Arbeitgeber geeignet sind. Der Programmkoordinator und das Praktikantenamt können Anleitung zur Auswahl möglicher Optionen geben.

Lernergebnisse:
Nach erfolgreichem Abschluss des Moduls sind die Studierenden in der Lage, ihr theoretisches Wissen in der Praxis anzuwenden. Darüber hinaus sind sie in der Lage, sich in neue Unternehmen zu integrieren und deren Struktur zu analysieren und zu bewerten.

Lehr- und Lernmethoden:

Medienform:

Literatur:

Modulverantwortliche(r):
Friederike Dörr – Praktikantenamt Weihenstephan – www.praktikantenamt-weihenstephan.de Alte Akademie 1, 85354 Freising, 08161 / 71-3710, friederike.doerr@paw.bayern.de

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Master's Thesis | Master's Thesis

Modulbeschreibung

WZ2754: Master's Thesis | Master's Thesis

Modulbeschreibungsversion: Gültig ab Wintersemester 2016/17

Modulniveau: Master	**Sprache:** Englisch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 30	**Gesamtstunden:** 900	**Eigenstudiums-stunden:** 890	**Präsenzstunden:** 10

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
The assessment in this module is based on the successful completion of the Master's Thesis including the starting Master's Thesis Proposal. In order to promote the competences required for the Master´s thesis, the proposal should be submitted before the registration of the thesis

Wiederholungsmöglichkeit:
Folgesemester

(Empfohlene) Voraussetzungen:
None

Inhalt:
The Master Thesis is the closure project of the program on which students have the opportunity to show their availability to work independently and adapt to a problem in a limited period of time. The student selects a topic of his/her own choice on which he/she will work according to scientific methods. A combination of the master’s thesis and an internship is possible if the rules for internships are kept. It would be ideal if student’s master’s thesis is based on the internship experience. Discussing the topic and the methods with a guiding professor or lecturer before starting the master’s thesis is absolutely necessary. Therefore, for all students a starting seminar "Master’s Thesis Proposal" is offered to guide them 1) theoretically in structuring their 6 months’ work and 2) in practice in writing a proposal which outlines their thesis topic including the state of knowledge, the research gaps, the goal of the Master's Thesis, the planned methods and - which is really important - a working and a financial plan. It also includes training on literacy strategy.

The thesis must be written under supervision of a tutor who must be a lecturer of TUM and has the approval to conduct exams at TUM. It is recommended to select a lecturer of the “Sustainable

Resource Management” Program. The tutor will in the end evaluate and mark the master’s thesis. The thesis can be done at the faculty, outside the university, abroad or in the student’s home-country, with previous consent of the tutor. Students can start writing their thesis in the fourth semester of the Master Program. To officially register the master’s thesis, students have to hand in the application form for the master’s thesis in the program coordination office The form has to be completed together with the tutor. After this registration the student has a timeframe of six months to finish the master’s thesis.

Lernergebnisse:
After finishing the module the students have the availability to work independently and adapt to a problem in a limited period of time. Additionally, they are able to draw conclusions from the data they found and to present and discuss their results in an appropriate way.

Lehr- und Lernmethoden:
Learning activities: literature search, scientific reading, to solve problems, to practice, to design an experiment, to create a scientific proposal and a scientific thesis, to constructive critique their own work and to revise it on basis of feedback, all parts under time constraints. Therefore, the learning methods are: an introduction lecture to support a structured procedure and peer instructions for their individual work.

Medienform:
Dependent on the topic of the thesis; e.g. specialized literature, software

Literatur:
Dependent on the topic of the thesis

Modulverantwortliche(r):
General information: Dr. Eva Bauer (Program Coordinator) Studienfakultät Forstwissenschaft und Ressourcenmanagement, Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, 08161/71-4464; srm@wzw.tum.de;

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Master's Thesis Proposal (Seminar, 1 SWS)
Weber-Blaschke G
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Nachweis Deutschkenntnisse | Requirement Proof of Proficiency in German

Modulbeschreibung

WZ8000: Anerkennung Nachweis Deutschkenntnisse | Accredited Requirement Proof of Proficiency in German

Modulbeschreibungsversion: Gültig ab Sommersemester 2018

Modulniveau:	Sprache:	Semesterdauer:	Häufigkeit:
Credits:*	**Gesamtstunden:**	**Eigenstudiums-stunden:**	**Präsenzstunden:**

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:

Inhalt:

Lernergebnisse:

Lehr- und Lernmethoden:

Medienform:

Literatur:

Modulverantwortliche(r):

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

SZ03011: Blockkurs Deutsch als Fremdsprache A1.1 | Intensive Course German as a Foreign Language A1.1

Modulbeschreibungsversion: Gültig ab Sommersemester 2010

Modulniveau: Bachelor/Master	**Sprache:** Unterrichtete Sprache	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 4	**Gesamtstunden:** 120	**Eigenstudiums-stunden:** 60	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
1 schriftlicher End Term Test 90 min. (100%) - keine Hilfsmittel erlaubt
In der schriftlichen Prüfung werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Sie beinhaltet Fragen zur Anwendung von Wortschatz und Grammatik, zu Text- bzw. Leseverstehen, sowie Aufgaben zur freien Textproduktion. Das Hörverstehen wird anhand von Hörbeispielen mit Hörverstehens-Fragen überprüft, die schriftlich beantwortet werden müssen. Mündliche Reaktionsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft.

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:
Keine

Inhalt:
In diesem Modul werden Grundkenntnisse in Deutsch als Fremdsprache unter Berücksichtigung interkultureller und landeskundlicher Aspekte vermittelt, die es den Studierenden ermöglichen, sich in alltäglichen Grundsituationen - z.B. beim Einkaufen, im Restaurant, im öffentlichen Verkehr etc. - trotz geringer Sprachkenntnisse zurechtzufinden.
Sie lernen/üben grundlegendes Vokabular zu Themen wie Familie, Beruf, Freizeit und Ernährung, Plural der Nomen, Personal- und Demonstrativpronomen und einfache Negationsformen, einfache Fragen zur Person/zur Familie zu stellen und zu beantworten, Zahlen, Preise und Uhrzeiten zu verstehen und zu benutzen und in einfach strukturierten Hauptsätzen Alltägliches im Präsens zu berichten.

Es werden Möglichkeiten aufgezeigt, den Lernprozess in der Fremdsprache eigenverantwortlich und effektiv zu gestalten. Die Studierenden üben Teamkompetenz durch kooperatives Handeln in multinational gemischten Gruppen.

Lernergebnisse:
Das Modul orientiert sich am Niveau A1 des GER.
Nach Abschluss dieses Moduls sind die Studierenden in der Lage alltägliche Ausdrücke und sehr einfache Sätze zu verwenden, die auf die Befriedigung konkreter Bedürfnisse des alltäglichen Bedarfs zielen: Er/Sie kann sich und andere vorstellen und anderen Leuten Fragen zu ihrer Person stellen und auf Fragen dieser Art Antwort geben, in einfacher Weise Tagesabläufe beschreiben und einfache schriftliche Mitteilungen zur Person machen. Er /Sie kann seine/ihre Wünsche kommunizieren, wenn die Gesprächspartner deutlich und langsam sprechen und bereit sind zu helfen.

Lehr- und Lernmethoden:
Das Modul besteht aus einem Seminar, in dem die angestrebten Lerninhalte mit gezielten Hör-, Lese-, Schreib- und Sprechübungen erarbeitet werden. Durch die Kombination dieser Übungen in Einzel-, Partner- und Gruppenarbeit wird der kommunikative und handlungsorientierte Ansatz umgesetzt. Durch kontrolliertes Selbstlernen grundlegender grammatischer Phänomene und Kommunikationsmuster in der Fremdsprache mit vorgegebenen (online-) Materialien werden die im Seminar vermittelten Grundlagen vertieft.
Freiwillige Hausaufgaben (zur Vor- und Nacharbeitung) festigen das Gelernte.

Medienform:
Lehrbuch; multimedial gestütztes Lehr- und Lernmaterial (Tafel, Folie, Übungsblätter, Bild, Film, etc.), auch online

Literatur:
Lehrbuch (wird im Kurs bekannt gegeben).

Modulverantwortliche(r):

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

SZ03021: Blockkurs Deutsch als Fremdsprache A1.2 | Intensive Course German as a Foreign Language A1.2

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Bachelor/Master	**Sprache:** Unterrichtete Sprache	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 4	**Gesamtstunden:** 120	**Eigenstudiums-stunden:** 60	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
1 schriftlicher End Term Test 90 min. (100%) - keine Hilfsmittel erlaubt
In der schriftlichen Prüfung werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Sie beinhaltet Fragen zur Anwendung von Wortschatz und Grammatik, zu Text- bzw. Leseverstehen, sowie Aufgaben zur freien Textproduktion. Das Hörverstehen wird anhand von Hörbeispielen mit Hörverstehens-Fragen überprüft, die schriftlich beantwortet werden müssen. Mündliche Reaktionsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft.

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:
Gesicherte Kenntnisse der Stufe A1.1; Einstufungstest mit Ergebnis A1.2.

Inhalt:
In diesem Modul werden Grundkenntnisse in Deutsch als Fremdsprache unter Berücksichtigung interkultureller und landeskundlicher Aspekte vermittelt, die es den Studierenden ermöglichen, sich in alltäglichen Grundsituationen - z.B. beim Einkaufen, im Restaurant, im öffentlichen Verkehr etc. - trotz geringer Sprachkenntnisse zurechtzufinden.
Sie lernen/üben grundlegendes Vokabular zu Themen wie Familie, Beruf, Freizeit, Essen und Wohnen zu benutzen und in einfach strukturierten Hauptsätzen Alltägliches im Präsens und Perfekt zu berichten, den Gebrauch der Modalverben, des Imperativ und der Wechselpräpositionen.
Es werden Möglichkeiten aufgezeigt, den Lernprozess in der Fremdsprache eigenverantwortlich und effektiv zu gestalten. Die Studierenden üben Teamkompetenz durch kooperatives Handeln in multinational gemischten Gruppen.

Lernergebnisse:
Das Modul orientiert sich am Niveau A1 des GER.
Nach Abschluss dieses Moduls sind die Studierenden in der Lage alltägliche Ausdrücke und einfache Sätze zu verwenden, die auf die Befriedigung konkreter, in der Bewältigung des Alltags wesentlicher Bedürfnisse zielen:
Er/Sie kann einfache Fragen zu Person und Familie stellen und beantworten, Tagesabläufe in Vergangenheit und Gegenwart beschreiben und einfache schriftliche Mitteilungen zur Person machen, Verabredungen treffen und in grundlegenden alltäglichen Situationen beispielsweise beim Einkauf oder im Restaurant seine/ihre Wünsche erfolgreich kommunizieren, wenn die Gesprächspartner langsam und deutlich sprechen und bereit sind zu helfen.

Lehr- und Lernmethoden:
Das Modul besteht aus einem Seminar, in dem die angestrebten Lerninhalte mit gezielten Hör-, Lese-, Schreib- und Sprechübungen erarbeitet werden. Durch die Kombination dieser Übungen in Einzel-, Partner- und Gruppenarbeit wird der kommunikative und handlungsorientierte Ansatz umgesetzt. Durch kontrolliertes Selbstlernen grundlegender grammatischer Phänomene und Kommunikationsmuster in der Fremdsprache mit vorgegebenen (online-) Materialien werden die im Seminar vermittelten Grundlagen vertieft.
Freiwillige Hausaufgaben (zur Vor- und Nacharbeitung) festigen das Gelernte

Medienform:
Lehrbuch; multimedial gestütztes Lehr- und Lernmaterial (Tafel, Folie, Übungsblätter, Bild, Film, etc.), auch online

Literatur:
Lehrbuch (wird im Kurs bekannt gegeben).

Modulverantwortliche(r):

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

SZ03031: Blockkurs Deutsch als Fremdsprache A2.1 | Intensive Course German as a Foreign Language A2.1

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Bachelor/Master	**Sprache:** Deutsch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 4	**Gesamtstunden:** 120	**Eigenstudiums-stunden:** 60	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
1 schriftlicher End Term Test 90 min. (100%) - keine Hilfsmittel erlaubt
In der schriftlichen Prüfung werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Sie beinhaltet Fragen zur Anwendung von Wortschatz und Grammatik, zu Text- bzw. Leseverstehen, sowie Aufgaben zur freien Textproduktion. Das Hörverstehen wird anhand von Hörbeispielen mit Hörverstehens-Fragen überprüft, die schriftlich beantwortet werden müssen. Mündliche Reaktionsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft.

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:
Gesicherte Kenntnisse der Stufe A1.2; Einstufungstest mit Ergebnis A2.1.

Inhalt:
In diesem Modul werden Grundkenntnisse in Deutsch als Fremdsprache unter Berücksichtigung interkultureller und landeskundlicher Aspekte vermittelt, die es den Studierenden ermöglichen, sich in alltäglichen Grundsituationen zurechtzufinden, z.B. auf Reisen, beim Arzt, auf Wohnungssuche, im Kaufhaus, unter Kollegen, Freunden und Nachbarn.
Sie lernen/üben grundlegendes Vokabular/Ausdrucksmöglichkeiten zu Themen wie Ausbildung, Beruf, Gesundheit, Wohnen und Reisen. Sie lernen/üben, einfach strukturierte Haupt- und Nebensätze (z.B. dass, weil, und, denn, etc.) zu benutzen, im Präteritum (Modalverben) und Perfekt zu berichten, den Gebrauch des Komparativ und Superlativ und die Deklination des Adjektivs. Sie wiederholen und erweitern den Gebrauch der Präpositionen im Akkusativ und Dativ. Es werden Strategien vermittelt, die mündlich wie schriftlich eine Verständigung trotz noch geringer Sprachkenntnisse ermöglichen. Außerdem werden Möglichkeiten aufgezeigt, den Lernprozess

eigenverantwortlich effektiver zu gestalten und damit die eigene Lernfähigkeit zu verbessern. Die Studierenden üben Teamkompetenz durch kooperatives Handeln in multinational gemischten Gruppen.

Lernergebnisse:
Das Modul orientiert sich am Niveau A2 des GER.
Nach Abschluss dieses Moduls sind die Studierenden in der Lage im Gespräch einfache Sätze und Redewendungen zu einem erweiterten Spektrum an vertrauten Themen zu verstehen und gebrauchen. Dabei handelt es sich um grundlegende Informationen zu alltäglichen oder studien- bzw. berufsrelevanten Themen unter Einbeziehung landeskundlicher Aspekte.
Er/Sie kann beispielsweise sich und andere Personen, persönliche Wohnsituation, Gesundheitszustand, Freizeitverhalten und berufliche Situation beschreiben.
Der/die Studierende kann längere Texte und Briefe zu vertrauten Themen verstehen, in denen gängige aber einfache alltags- oder berufsbezogene Sprache verwendet wird und in denen vorhersehbare Informationen zu finden sind. Er/Sie ist in der Lage kurze, informative Texte oder Mitteilungen zu grundlegenden Situationen in Alltag und Studium zu verfassen.

Lehr- und Lernmethoden:
Das Modul besteht aus einem Seminar, in dem die angestrebten Lerninhalte mit gezielten Hör-, Lese-, Schreib- und Sprechübungen erarbeitet werden. Durch die Kombination dieser Übungen in Einzel-, Partner- und Gruppenarbeit wird der kommunikative und handlungsorientierte Ansatz umgesetzt. Durch kontrolliertes Selbstlernen grundlegender grammatischer Phänomene und Kommunikationsmuster in der Fremdsprache mit vorgegebenen (online-) Materialien werden die im Seminar vermittelten Grundlagen vertieft.
Freiwillige Hausaufgaben (zur Vor- und Nacharbeitung) festigen das Gelernte.

Medienform:
Lehrbuch; multimedial gestütztes Lehr- und Lernmaterial (Tafel, Folie, Übungsblätter, Bild, Film, etc.), auch online

Literatur:
Lehrbuch (wird im Kurs bekannt gegeben)

Modulverantwortliche(r):

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Blockkurs Deutsch als Fremdsprache A2.1 (Seminar, 4 SWS)
Gemaljevic J, Kretschmann A, Niebisch D, Semeraro G
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

SZ03051: Blockkurs Deutsch als Fremdsprache B1.1 | Intensive Course German as a Foreign Language B1.1

Modulbeschreibungsversion: Gültig ab Wintersemester 2015/16

Modulniveau: Bachelor/Master	**Sprache:** Deutsch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 4	**Gesamtstunden:** 120	**Eigenstudiums-stunden:** 60	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
1 schriftlicher End Term Test 90 min. (100%) - keine Hilfsmittel erlaubt
In der schriftlichen Prüfung werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Sie beinhaltet Fragen zur Anwendung von Wortschatz und Grammatik, zu Text- bzw. Leseverstehen, sowie Aufgaben zur freien Textproduktion. Das Hörverstehen wird anhand von Hörbeispielen mit Hörverstehens-Fragen überprüft, die schriftlich beantwortet werden müssen. Mündliche Reaktionsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft.

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:
Gesicherte Kenntnisse der Stufe A2.2; Einstufungstest mit Ergebnis B1.1.

Inhalt:
In diesem Modul werden Kenntnisse in Deutsch als Fremdsprache unter Berücksichtigung interkultureller, landeskundlicher und studienbezogener Aspekte erarbeitet, die es den Studierenden ermöglichen, sich in vertrauten Situationen, z.B. in Studium, Arbeit, Freizeit und Familie, und zu Themen von allgemeinem Interesse wie Film, Musik, Sport etc. selbständig und sicher in der Zielsprache zu verständigen, wenn Standardsprache verwendet wird.
Die Studierenden erweitern und benutzen ein grundlegendes Repertoire an logischen Haupt- und Nebensatz-Strukturen (z.B. Infinitivsatz, Finalsatz, Konsekutivsatz, Relativsatz) und an Verben und Nomen mit Präpositionalergänzung. Sie lernen/üben den Genitiv, die Funktion und den Gebrauch des Konjunktiv II und des Futur I. Sie wiederholen und ergänzen elementare Aspekte der Grammatik wie den Gebrauch der Zeiten und der Präpositionen.

Die Studierenden beschäftigen sich mit kulturspezifischen Besonderheiten, beispielsweise in Bezug auf Feste und Gebräuche, Ausbildungssysteme, Berufswelt, Lebensformen und Freizeitverhalten und gewinnen Einblicke in die zeitgenössischen Kulturszene Deutschlands. Die Studierenden üben Teamkompetenz durch kooperatives Handeln in multinational gemischten Gruppen.

Lernergebnisse:
Das Modul orientiert sich am Niveau B1 des GER.
Nach Abschluss des Moduls sind die Studierenden in der Lage sich in den meisten Situationen, denen man in Studium, Beruf und Freizeit im Sprachgebiet begegnet, sicher zu verständigen.
Er/Sie kann Aspekte des schulischen und beruflichen Werdegangs referieren, Pläne, Wünsche und Hoffnungen äußern, Einladungen aussprechen, annehmen oder ablehnen, Ratschläge und Anweisungen erteilen, Meinungen äußern und argumentieren.
Er/Sie kann wesentliche Inhalte in einfachen, authentischen Texten aus alltäglichen Bereichen verstehen und wiedergeben und sich spontan an Gesprächen zu vertrauten Themen beteiligen.
Er/Sie kann längere persönliche Briefe und Texte zu eigenen Erfahrungen verfassen.

Lehr- und Lernmethoden:
Das Modul besteht aus einem Seminar, in dem die angestrebten Lerninhalte mit gezielten Hör-, Lese-, Schreib- und Sprechübungen erarbeitet werden. Durch die Kombination dieser Übungen in Einzel-, Partner- und Gruppenarbeit wird der kommunikative und handlungsorientierte Ansatz umgesetzt. Durch kontrolliertes Revidieren der Grundgrammatik im Selbststudium mit vorgegebenen (online-) Materialien werden die im Seminar vermittelten Inhalte vertieft.
Freiwillige Hausaufgaben (zur Vor- und Nacharbeitung) festigen das Gelernte.

Medienform:
Lehrbuch; multimedial gestütztes Lehr- und Lernmaterial (Tafel, Folie, Übungsblätter, Bild, Film, etc.), auch online.

Literatur:
Lehrbuch (wird im Kurs bekannt gegeben)

Modulverantwortliche(r):

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Blockkurs Deutsch als Fremdsprache B1.1 (Seminar, 4 SWS)
Niebisch D, Oelmayer J, Schimmack B, Stoephasius J
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

SZ0303: Deutsch als Fremdsprache A2.1 | German as a Foreign Language A2.1

Modulbeschreibungsversion: Gültig ab Wintersemester 2019/20

Modulniveau: Bachelor/Master	**Sprache:** Deutsch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
1 schriftlicher End Term Test 90 min. (100%) - keine Hilfsmittel erlaubt
In der schriftlichen Prüfung werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Sie beinhaltet Fragen zur Anwendung von Wortschatz und Grammatik, zu Text- bzw. Leseverstehen, sowie Aufgaben zur freien Textproduktion. Das Hörverstehen wird anhand von Hörbeispielen mit Hörverstehens-Fragen überprüft, die schriftlich beantwortet werden müssen. Mündliche Reaktionsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft.

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:
Gesicherte Kenntnisse der Stufe A1.2; Einstufungstest mit Ergebnis A2.1.

Inhalt:
In diesem Modul werden Grundkenntnisse in Deutsch als Fremdsprache unter Berücksichtigung interkultureller und landeskundlicher Aspekte vermittelt, die es den Studierenden ermöglichen, sich in alltäglichen Grundsituationen zurechtzufinden, z.B. auf Reisen, beim Arzt, auf Wohnungssuche, im Kaufhaus, unter Kollegen, Freunden und Nachbarn.
Sie lernen/üben grundlegendes Vokabular/Ausdrucksmöglichkeiten zu Themen wie Ausbildung, Beruf, Gesundheit, Wohnen und Reisen. Sie lernen/üben, einfach strukturierte Haupt- und Nebensätze (z.B. dass, weil, und, denn, etc.) zu benutzen, im Präteritum (Modalverben) und Perfekt zu berichten, den Gebrauch des Komparativ und Superlativ und die Deklination des Adjektivs. Sie wiederholen und erweitern den Gebrauch der Präpositionen im Akkusativ und Dativ. Es werden Strategien vermittelt, die mündlich wie schriftlich eine Verständigung trotz noch geringer Sprachkenntnisse ermöglichen. Außerdem werden Möglichkeiten aufgezeigt, den Lernprozess

eigenverantwortlich effektiver zu gestalten und damit die eigene Lernfähigkeit zu verbessern. Die Studierenden üben Teamkompetenz durch kooperatives Handeln in multinational gemischten Gruppen.

Lernergebnisse:
Das Modul orientiert sich am Niveau A2 des GER.
Nach Abschluss dieses Moduls sind die Studierenden in der Lage im Gespräch einfache Sätze und Redewendungen zu einem erweiterten Spektrum an vertrauten Themen zu verstehen und gebrauchen. Dabei handelt es sich um grundlegende Informationen zu alltäglichen oder studien- bzw. berufsrelevanten Themen unter Einbeziehung landeskundlicher Aspekte.
Er/Sie kann beispielsweise sich und andere Personen, persönliche Wohnsituation, Gesundheitszustand, Freizeitverhalten und berufliche Situation beschreiben.
Der/die Studierende kann längere Texte und Briefe zu vertrauten Themen verstehen, in denen gängige aber einfache alltags- oder berufsbezogene Sprache verwendet wird und in denen vorhersehbare Informationen zu finden sind. Er/Sie ist in der Lage kurze, informative Texte oder Mitteilungen zu grundlegenden Situationen in Alltag und Studium zu verfassen.

Lehr- und Lernmethoden:
Das Modul besteht aus einem Seminar, in dem die angestrebten Lerninhalte mit gezielten Hör-, Lese-, Schreib- und Sprechübungen erarbeitet werden. Durch die Kombination dieser Übungen in Einzel-, Partner- und Gruppenarbeit wird der kommunikative und handlungsorientierte Ansatz umgesetzt. Durch kontrolliertes Selbstlernen grundlegender grammatischer Phänomene und Kommunikationsmuster in der Fremdsprache mit vorgegebenen (online-) Materialien werden die im Seminar vermittelten Grundlagen vertieft.
Freiwillige Hausaufgaben (zur Vor- und Nacharbeitung) festigen das Gelernte.

Medienform:
Lehrbuch; multimedial gestütztes Lehr- und Lernmaterial (Tafel, Folie, Übungsblätter, Bild, Film, etc.), auch online

Literatur:

Modulverantwortliche(r):

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Deutsch als Fremdsprache A2.1 (Seminar, 4 SWS)
Aßmann J, Bauer G, Comparato G, Geishauser C, Gemaljevic J, Keza I, Kovacs O, Kutschker T, Nierhoff-King B, Schlüter J, Semeraro G
Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

SZ0304: Deutsch als Fremdsprache A2.2 | German as a Foreign Language A2.2

Modulbeschreibungsversion: Gültig ab Wintersemester 2019/20

Modulniveau: Bachelor/Master	**Sprache:** Deutsch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 6	**Gesamtstunden:** 180	**Eigenstudiums-stunden:** 120	**Präsenzstunden:** 60

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
1 End Term Test 90 Min. (100%) - keine Hilfsmittel erlaubt
In der schriftlichen Prüfung werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Sie beinhaltet Fragen zur Anwendung von Wortschatz und Grammatik, zu Text- bzw. Leseverstehen, sowie Aufgaben zur freien Textproduktion. Das Hörverstehen wird anhand von Hörbeispielen mit Hörverstehens-Fragen überprüft, die schriftlich beantwortet werden müssen. Mündliche Reaktionsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft.

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:
Gesicherte Kenntnisse der Stufe A2.1; Einstufungstest mit Ergebnis A2.2.

Inhalt:
In diesem Modul werden Grundkenntnisse in Deutsch als Fremdsprache unter Berücksichtigung interkultureller und landeskundlicher Aspekte vermittelt, die es den Studierenden ermöglichen, sich in alltäglichen Grundsituationen zurechtzufinden, z.B. auf Reisen, beim Arzt, auf Wohnungssuche, im Kaufhaus, unter Kollegen, Freunden und Nachbarn.
Sie wiederholen und ergänzen grundlegendes Vokabular /Ausdrucksmöglichkeiten zu Themen wie Ausbildung, Beruf, Wohnen und Reisen. Sie lernen/üben ein erweitertes Spektrum an Haupt- und Nebensätzen (Finalsatz, indirekte Frage, temporaler Nebensatz, Kausalsatz) zu klassifizieren und zu benutzen, im Präteritum (Modalverben) und Perfekt zu berichten und sie wiederholen bzw. erweitern den Gebrauch der Adjektivdeklination und der Präpositionen.
Es werden Strategien vermittelt, die mündlich wie schriftlich eine Verständigung trotz noch geringer Sprachkenntnisse ermöglichen. Außerdem werden Möglichkeiten aufgezeigt, den Lernprozess

eigenverantwortlich effektiver zu gestalten und damit die eigene Lernfähigkeit zu verbessern. Die Studierenden üben Teamkompetenz durch kooperatives Handeln in multinational gemischten Gruppen.

Lernergebnisse:
Das Modul orientiert sich am Niveau A2 des GER.
Nach Abschluss dieses Moduls sind die Studierenden in der Lage im Gespräch einfache Sätze und Redewendungen zu einem erweiterten Spektrum an vertrauten Themen zu verstehen und gebrauchen. Dabei handelt es sich um grundlegende Informationen zu alltäglichen oder studien- bzw. berufsrelevanten Themen unter Einbeziehung landeskundlicher Aspekte.
Er/Sie kann beispielsweise sich und andere Personen, persönliche Wohnsituation, Gesundheitszustand, Freizeitverhalten und berufliche Situation beschreiben. Er/Sie kann sich bei der Wohnungssuche und in wesentlichen Situationen im Urlaub oder auf Reisen verständigen und von daraus resultierenden Erfahrungen und Erlebnissen in einfacher Standardsprache berichten.
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Lehr- und Lernmethoden:
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Freiwillige Hausaufgaben (zur Vor- und Nacharbeitung) festigen das Gelernte.

Medienform:
Lehrbuch; multimedial gestütztes Lehr- und Lernmaterial (Tafel, Folie, Übungsblätter, Bild, Film, etc.), auch online

Literatur:

Modulverantwortliche(r):

Lehrveranstaltungen (Lehrform, SWS) Dozent(in):
Deutsch als Fremdsprache A2.2 (Seminar, 4 SWS)
Aßmann J, Bauer G, Comparato G, Feistle C, Hagner V, Hanke C, Kostial M, Reulein C, Schimmack B, Selent D, Stiebeler H, Thiessen E

Für weitere Informationen zum Modul und seiner Zuordnung zum Curriculum klicken Sie bitte campus.tum.de oder hier.

Modulbeschreibung

SZ0322: Deutsch als Fremdsprache A2.1 plus A2.2 | German as a Foreign Language A2.1 plus A2.2

Modulbeschreibungsversion: Gültig ab Wintersemester 2019/20

Modulniveau:	**Sprache:** Deutsch	**Semesterdauer:** Einsemestrig	**Häufigkeit:** Wintersemester/ Sommersemester
Credits:* 8	**Gesamtstunden:** 240	**Eigenstudiums-stunden:** 150	**Präsenzstunden:** 90

* Die Zahl der Credits kann in Einzelfällen studiengangsspezifisch variieren. Es gilt der im Transcript of Records oder Leistungsnachweis ausgewiesene Wert.

Beschreibung der Studien-/ Prüfungsleistungen:
1 End Term Test 90 Min. (100%) - keine Hilfsmittel erlaubt

In der schriftlichen Prüfung werden die in der Modulbeschreibung angegebenen Lernergebnisse geprüft. Sie beinhaltet Fragen zur Anwendung von Wortschatz und Grammatik, zu Text- bzw. Leseverstehen, sowie Aufgaben zur freien Textproduktion. Das Hörverstehen wird anhand von Hörbeispielen mit Hörverstehens-Fragen überprüft, die schriftlich beantwortet werden müssen. Mündliche Reaktionsfähigkeiten werden anhand der Anwendung entsprechender Redemittel in schriftlichen Dialogbeispielen überprüft.

Wiederholungsmöglichkeit:

(Empfohlene) Voraussetzungen:
Gesicherte Kenntnisse der Stufe A1.2; Einstufungstest mit Ergebnis A2.1

Inhalt:
In diesem Modul werden Grundkenntnisse in Deutsch als Fremdsprache unter Berücksichtigung interkultureller und landeskundlicher Aspekte vermittelt, die es den Studierenden ermöglichen, sich in alltäglichen Grundsituationen zurechtzufinden, z.B. auf Reisen, beim Arzt, auf Wohnungssuche, im Kaufhaus, unter Kollegen, Freunden und Nachbarn.
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Alphabetisches Verzeichnis der Modulbeschreibungen

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