TUM School of Management
Technische Universität München

Module Catalog

B.Sc. Management and Technology (Heilbronn)
TUM School of Management
Technische Universität München

www.tum.de/
www.mgt.tum.de

Module Catalog: General Information and Notes to the Reader

What is the module catalog?
One of the central components of the Bologna Process consists in the modularization of university curricula, that is, the transition of universities away from earlier seminar/lecture systems to a modular system in which thematically-related courses are bundled together into blocks, or modules.
This module catalog contains descriptions of all modules offered in the course of study.
Serving the goal of transparency in higher education, it provides students, potential students and other internal and external parties with information on the content of individual modules, the goals of academic qualification targeted in each module, as well as their qualitative and quantitative requirements.

Notes to the reader:

Updated Information
An updated module catalog reflecting the current status of module contents and requirements is published every semester. The date on which the module catalog was generated in TUMonline is printed in the footer.

Non-binding Information
Module descriptions serve to increase transparency and improve student orientation with respect to course offerings. They are not legally-binding. Individual modifications of described contents may occur in praxis.
Legally-binding information on all questions concerning the study program and examinations can be found in the subject-specific academic and examination regulations (FPSO) of individual programs, as well as in the general academic and examination regulations of TUM (APSO).

Elective modules
Please note that generally not all elective modules offered within the study program are listed in the module catalog.

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Basics | Basics

Basic Courses (18 Cr have to be passed till the end of the 2nd semester) | Basic Courses (18 Cr have to be passed till the end of the 2nd semester)

Module Description

WIHN0001: Mathematics in Natural and Economic Science 1 | Mathematics in Natural and Economic Science 1 [MBNW 1]

Mathematik I

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module examination is based on a written exam (90 minutes). Students have to show their knowledge of basic concepts of linear algebra and analysis and can adequately apply them in example problems of natural and economic sciences.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:

Linear Algebra (vectors, matrices, subspaces, linear systems of equations, analytical geometry, determinants), sequences (linear recursions, limits, series), real functions (definition, polynomials, exponential functions, logarithms, power functions, limits and continuity), calculus (difference quotient, derivative, rules for computing derivatives, higher derivatives, shape of a graph, optimization, Taylor series), integral calculus (definite integral, computation of areas, antiderivative, fundamental theorem, rules for integration, applications), calculus of several variables (functions

of several variables, partial derivatives, gradient, Hessian, maxima and minima with and without constraints)

Intended Learning Outcomes:
After attending this module students are aware of fundamental mathematical structures and methods. Students are able to understand the basic concepts of Linear Algebra (vectors, matrices, subspaces, linear systems of equations, analytical geometry, determinants) and Calculus (for example: real functions, integral calculus, and calculus of several variables) and to apply them to problems in science and economics.

Teaching and Learning Methods:
The module consists of a series of lectures. In the lectures, theoretical principles and examples are presented.

Media:
- presentations

Reading List:

- N. Henze, G. Last: Mathematik für Wirtschaftsingenieure 1, 2. Aufl., Vieweg, 2005.
- G. Merziger, T. Wirth: Repetitorium der höheren Mathematik. Binomi, 1999.
- K. Meyberg, P. Vachenauer: Höhere Mathematik 1+2. Springer, 2001.
- O. Opitz: Mathematik. Lehrbuch für Ökonomen. Oldenbourg, 2002.
- M. Precht, K. Voit, R. Kraft: Mathematik für Nichtmathematiker 1+2. Oldenbourg, 1994.
- F. Pfuff: Mathematik für Wirtschaftswissenschaftler 1: Grundzüge der Analysis - Funktionen einer Variablen. 5. Aufl.,Vieweg, 2008.
- H. Pruscha, D. Rost: Mathematik für Naturwissenschaftler. Springer, 2008.
- L. Rade, B. Westergren, P. Vachenauer: Springers mathematische Formeln. Springer, 2000.
- J. Tietze: Einführung in die angewandte Wirtschaftsmathematik. 15. Aufl., Vieweg, 2009.
- K. Sydsaeter, O. Hammond: Mathematik für Wirtschaftswissenschaftler. 2. Aufl., Pearson, 2006.

Responsible for Module:
Xie, Jingui; Ph.D.

Courses (Type of course, Weekly hours per semester), Instructor:
Mathematics - Ergänzende Übung (Tutorium) BMT Campus Heilbronn (WIHN0001) (Übung, 2 SWS)
Lou Z

Mathematics in Natural and Economic Science I (BMT Campus Heilbronn) (WIHN0001) (Vorlesung, 4 SWS)
Xie J
For further information in this module, please click campus.tum.de or here.

Module Description

WIHN0002: Statistics for Business Administration | Statistics for Business Administration

Version of module description: Gültig ab summerterm 2020

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:

The module examination is based on a written exam (90 minutes). Students have to know basic terms and concepts of statistics and probility calculus and can choose appropriate statistical evaluation methods. They are able to understand and adequately interpret the given R Output.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Mathematics in Natural and Economic Science 1

Content:
Descriptive statistics:
- measures of location and variation
- graphical representation of uni- and bivariate data
- measures of association for bivariate data
- descriptive linear regression

Probability calculus:
- examples of discrete and continuous probability distributions
- conditional probabilities
- stochastic independence
- random variables and their distribution functions and moments
- conditional distributions

Statistical inference:

- confidence intervals
- hypothesis tests
- basic ideas of multiple linear regression

Introduction to the statistical software package R and guidance on how to perform simple statistical analyses in R.

Intended Learning Outcomes:

At the end of the module students are able to apply the basic methods of descriptive statistics and statistical inference and can draw correct conclusions from the results of these statistics. Further they know how to apply the basic methods of probability calculus. The students also know how to perform in R the basic statistical methods introduced in the module. They should also be aware of the capabilities and the limitations of the statistical methods introduced in the lecture.

Teaching and Learning Methods:
The module consists of a series of lectures supplemented by exercise sessions. In the lectures, theoretical principles and examples are presented. In the exercise sessions, problems which illustrate and deepen the topics of the lectures are discussed. Optionally, additional exercise classes can be offered in which students work on problems, either independently or guided by mentors, and preferably in teamwork. Between classes the students will be supported in their self-study through a discussion forum.

Media:
e-learning (Moodle), lecture notes, exercise sheets, using a whiteboard app

Reading List:
[1] Caputo, A., Fahrmeir, L., Künster, R., Lang, S., Pigeot, I., Tutz, G (2009). Arbeitsbuch Statistik. Springer.
[2] Cramer, E., Kamps, U. (2007). Grundlagen der Wahrscheinlichkeitsrechnung und Statistik, Springer.
[3] Diesz, D., Barr, C., and Cetinkaya-Rundel, M. (2015). OpenIntro Statistics, 3rd edition, https://www.openintro.org/stat/textbook.php
[4] Fahrmeir, L., Künster, R., Pigeot, I., Tutz, G. (2009). Statistik: Der Weg zur Datenanalyse. Springer.
[5] Field, A., Miles, J. and Field, Z. (2012). Discovering Statistics Using R. SAGE.
[6] Verzani, J. (2004). Using R for Introductory Statistics. Chapman & Hall.

Responsible for Module:
Stich, Michael; Prof. Dr. rer. oec.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WIHN0021_E: Economics I - Microeconomics | Economics I - Microeconomics [ECON 1]

Microeconomics

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In the exam (written, 120 minutes) students should demonstrate their ability to adequately interpret the microeconomic concepts and apply the methods worked on in class, in limited time and without aid. By means of multiple-choice-questions, which are either embedded in a context/case/scenario or require prior computation, students' capacity to apply the learned solution strategies to new settings and draw correct economic implications is assessed.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
This module provides an introduction to basic concepts of microeconomics. It deals with the behaviour of individual economic units, such as households, business firms, and public institutions. Another concern is how these units interact to form markets and industries. How can consumer decisions be explained and how can aggregate demand be derived from consumer choice? Which are the factors that determine the production decisions of companies? How do equilibrium prices emerge in competitive markets, how in monopoly markets? What is the effect of government interventions in markets (e.g. taxes, price controls)? How does market power affect social welfare? Which factors lead to market failure?

Intended Learning Outcomes:
After attending this module, students will be able to describe economic tradeoffs (particularly in choice under scarcity situations of consumers and firms). Moreover, they know strategies to solve

those tradeoffs and are capable of applying them to new situations. Students are able to explain the fundamental economic mechanisms underlying specialisation and trade (particularly in view of technological progress). Students can predict how government interventions (e.g. taxes, price controls) will affect simple competitive markets. They are able to explain why certain industries are prone to market concentration and how market power affects social welfare. They can distinguish which types of goods are efficiently provided on free markets, and which not.

Teaching and Learning Methods:
An interactive lecture introduces essential microeconomic concepts and theories and illustrates them with the help of topical empirical examples. Classroom experiments complement the classic bird-eye's perspective by nudging students to put themselves in the positition of particular economic players, thereby requiring them to actively reflect the concepts introduced. Online surveys at the end of each chapter enable students to select which topics they would like to intensify in subsequent classes. In the accompaying exercise class, students practice, on specific problems and examples, the mathematical techniques needed to develop a deeper understanding of the economic concepts. In self-study students use the textbook to repeat the concepts introduced in class and apply them to additional examples.

Media:
Textbook, slides, exercise sheets, classroom experiments, online surveys

Reading List:
Robert S. Pindyck and David L. Rubinfeld, Microeconomics, 8th Edition, Pearson, 2013 (ISBN 13: 978-0-13-285712-3). UND Robert S. Pindyck und David L. Rubinfeld, Mikroökonomie, 8. Aufl., Pearson Studium, 2013 (ISBN-13: 978-3868941678).

Responsible for Module:
Lergetporer, Philipp; Prof. Ph.D.

Courses (Type of course, Weekly hours per semester), Instructor:
Economics I - Exercise (BMT Campus Heilbronn) (WIHN0021_E) (Übung, 2 SWS)
Baier H, Lergetporer P

Economics I - Lecture (BMT Campus Heilbronn) (WIHN0021_E) (Vorlesung, 2 SWS)
Lergetporer P
For further information in this module, please click campus.tum.de or here.

Module Description

WIHN0275_E: Management Science | Management Science [MS]

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Students mastery of the content taught in this module is checked with a 60 minutes written exam. Students are only allowed to use a non-programmable calculator. In the exam students have to answer questions, apply algorithms to solve problems, create mathematical models for small example problems, and discuss presented results. By this the students have to demonstrate that they have understood and can apply the mathematical models and methods to solve business planning problems. The overall grade of the module is based on the result obtained in the written exam.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Knowledge of Mathematics and Statistics at the level as definend in the German Abitur

Content:
Management Science is about modeling, solving and analyzing planning and decision problems using mathematial concepts. Management Science is used across different industries, departments and organizations. The lecture will treat the Management Science approach to decision making in general and the following topics in particular: Linear Programming, Mixed-Integer Programming, Graph Theory, Netwerk Flow, Dynamic Programming and Decision Theory.

Intended Learning Outcomes:
After successful completion of the module students are capable of modelling planning problems. They are able to solve small business problems manually by using models and methods of linear and horizontal programming, of graph theory, of network flow, of dynamic programming, and of decision theory.

Teaching and Learning Methods:
The module consists of a lecture and exercise courses, which are provided weekly. In the lecture the content is jointly developed with the students mainly by using slides. The exercise course repeats parts of the lecture contents by using examples. Students have to prepare the exercises and have the opportunity to pose questions.

Media:
Presentation slides

Reading List:
Bradley, S.P., A.C. Hax und T.L. Magnanti: Applied Mathematical Programming, Addison-Wesley, 1977. Domschke W and A. Drexl: Einführung in Operations Research, 9th Ed., Springer, 2015.
Hillier FS and Lieberman GJ: Introduction to Operations Research, 9th ed., McGraw-Hill, 2010.
Winston WL: Operations Research, 5th Ed., Thomson, 2004.
Hillier FS and Lieberman GJ: Introduction to Operations Research, 9th ed., McGraw-Hill, 2010.
Winston WL: Operations Research, 5th Ed., Thomson, 2004.

Responsible for Module:
Kiesmüller, Gudrun; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Management Science - Lecture (WIHN0275_E) (BMT Campus Heilbronn) (Vorlesung, 2 SWS)
Kiesmüller G

Management Science - Exercise (WIHN0275_E) (BMT Campus Heilbronn) (Übung, 2 SWS)
Kiesmüller G, Mitsakos T, Ralfs J
For further information in this module, please click campus.tum.de or here.

Basics in Management | Basics in Management

Module Description

WIHN0219_E: Investment and Financial Management | Investment and Financial Management

Version of module description: Gültig ab winterterm 2019/20

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The grading is based on a written exam with a duration of 120 minutes. To test whether the students acquired the theoretical basics in financial analysis and investment planning, multiple choice questions are asked, where they have to find the correct or incorrect statement among several alternative statements. By using a calculator and the formulary issued by the chair, the students for exapmle have to analyse investment projects, create the optimal capital stucture of projects or firms, evaluate bonds, stocks, or equity options, and have to choose the right alternative from various possible answers as the exam is in form of multiple choice questions.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
The module will give students a braod understanding of the instruments to analyse and evaluate investment opportunities. Subsequent, a complete list of these methods:
- Financial Statement Analysis (balance sheet analysis, analysis of profut and loss account)
- Investment Analysis (net present value method, actuarial return)
- Capital Budgeting (determination of free cashflows, choosing between alternatives)
- Cost of Capital (equity costs, borrowing costs, capital costs)
- Capital Structure

Intended Learning Outcomes:
Upon completion of this module students will be able to: (1) to name and apply important measures of company performance, (2) to analyze and choose investment projects, (3) to create the optimal capital structure of projects and firms, (4) restate and employ concepts of financial mathematics and (5) to evaluate financial instruments.

Teaching and Learning Methods:
The module will combine several teaching methods.
• Weekly Lecture: Presentation of theoretical basics and applied examples, supported by slides. As a better learning effect is reached by a dynamic learning environment, the student can join in live surveys with onlineTED.
• Excercise available on several dates: Calculation of selected exercises from the set of exercises in small groups so the students can directly ask questions about the calculations.
• Set of exercises with applied examples for individual practising of exercises.

Media:
Presentations, exercises with solutions, onlineTED

Reading List:
Berk/DeMarzo, Corporate Finance, 3rd. Edition, Pearson.

Responsible for Module:
Müller, Sebastian; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WIHN0261: Empirical Research Methods | Empirical Research Methods [ERM]

Version of module description: Gültig ab winterterm 2019/20

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Exam
Grading is based on a 100% multipe-choice exam (120 minutes) with about 50-60 questions at the end of the lecture. The questions will be of different character and allow students to show that they have understood basic concepts of empirical research and that they can analyze and evaluate research design and research outputs on their empirical and conceptual accuracy

Extra credit (Mid term assignment)
Accompanying this class, you will be able to participate in two types of work to earn extra credit toward your grade. This means that completing this work is not mandatory, and full marks can be achieved without participating. The first assignment is a teamwork task and focuses on the comprehension of a chosen scientific paper of the management literature. Each student has to write a short précis (1-2 pages). The second assignment is an individual task and is about the systematic creation and processing of a data set. The workload for this task is on average about 4-6 hours. Both extra assignments help to improve class performance and can improve the final grade. Participating successfully in these assignments may improve the final grade by 0,3.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Mathematics, Statistics

Content:
Understanding how research works is essential for any student and practitioner of management. All insights we draw on—may they come from teaching, research, or actual business activities

—must meet a certain level of academic rigor to be trustworthy, and only trustworthy information should become a source of learning and a foundation of managerial decision making.

Topics:
• Research ethics
• Research question and their implications
• Paper reading, positioning, and contributions
• Correlation and causality
• Choosing a research design
• Qualitative research
• Quantitative analysys & quantitative research design
• Using existing scales and data
• Data preparation and descriptive statistics
• Advanced quants

Intended Learning Outcomes:
This module will give you an introduction to empirical research methods, including the higher aims of empirical research, the standards it needs to meet, and a set of methods that you can directly apply. By the end of the module, you will thus be able to understand the scientific process in general—and in the context of management studies in particular—and be able to evaluate whether a result or statement you are confronted with is indeed trustworthy. In doing so, not only will you become able to more critically evaluate everyday information (such as news items or pseudo-scientific studies) but you will also be prepared to participate in the scientific process yourself by improving your ability to read and understand academic work, and getting to know the steps you will need to take to make a contribution yourself, as you will be required to do in other parts of your study programs, such as in research seminars or your final thesis.

Knowledge Objectives
After the module students will be able to:
• understand the nature of the scientific process, in particular in the context of management studies
• explore different approaches toward solving (scientific) problems
• use and apply selected empirical research methods (e.g., for seminar of final theses)
• understand the structure and evaluate the quality of academic papers in management studies
• (in parts) create their own research projects

Skills Objectives
• improve diagnostic and analytical skills
• think creatively about how best to solve complex problems
• build up critical thinking as well as judgment and interpretation skills
• learn how to evaluate different strategic options
• work together efficiently and effectively in groups

Learning Objectives

At the end of this module, students will be able to demonstrate understanding, critical assessment and application of the following:
• assess (pseudo-)scientific work in general, and in particular in the context of management studies
• understand and evaluate potential approaches toward answering academic questions
• utilize tools and techniques of empirical research for their own future studies

Teaching and Learning Methods:
Lectures will be largely taught by an instructor based on a slide deck with some interactive elements.
Excercises will feature a lower number of slides and largely build on class contributions.
Exercises will actually take place in the computer pools (CIP) where you will be doing hands-on work.

In order to ensure you get most out of the module, we suggest you adhere to the principles that guide all our teaching:
Have fun
Our challenge is to make sure that you learn about the importance of empirical research methods and their relevance to and application in today's business environment. Importantly, even if you do not intend to embark on a career on an academic career, knowing about the research process and how it is executed well are essential pieces of knowledge for anyone in any industry. Thus, look at this class as an opportunity to acquire and sharpen a set of skills you will need in a couple of months/years when you might be working in a company, possible using or evaluating one of the methods explored in this very lecture!

Attend and prepare for class
While we understand that many of you will not be able to come to all sessions of this module, our hope and ambition is that you will try. Put differently, we promise to make the lectures interesting enough so that they are worth attending. Also, we will provide you with instructions as to how to prepare so that you can take the most out of each lecture – at the very least, you should have looked at these in advance! Note how your preparation is essential for the excercises and labs, the success for which depends on your contributions.

Participate Actively
Despite this being a fairly large class, we will try to conduct this module in an interactive manner. The more actively you participate during class, the better you will be prepared for the exam and the more of this module you will remember for your work life. Thus, do not try to hide in a large crowd, but summon your courage, take a chance, and rise to the challenge of participating.

Design your own learning experience
At several places throughout this module, we will give you an opportunity to participate in the design and execution of this module. For example, over the module of the term, you will have the

opportunity to contribute multiple choice question for each class, which everyone in the end can use to prepare for the exam.

Give feedback
Your feedback – in class or in private – on any aspect of this module is welcome at any time. It can help make this module an excellent experience for you and for us. We encourage you to comment on this module on Moodle and we will respond as quickly as possible. If you wish to see one of us in person, please let us know and schedule an appointment in advance so that we can prepare. Come prepared. I will also usually try to be available directly after the lecture.

Media:
Powerpoint, Board, Videos, Flipchart, Debates

Reading List:
For each session, we will upload individual preparation sheets specifying what we recommend you to have done before class. These sheets will also contain information on reading materials that elaborate on what we cover in class. Everything specified as “mandatory” by these preparation sheets is also part of the subject matter for the exam. All mandatory readings will be provided when they cannot be easily accessed through the library resources available to you. Also note how everything we do in class is relevant to the exam—importantly, this includes all questions asked in class, irrespective of whether they are answered in class.

In case you want to do preparatory or additional reading on empirical research methods, we recommend the following textbooks (on which we will also draw to some degree for the lecture):
• Singleton, R. A., Straits, B. C., & Straits M. M.1993 (or newer). Approaches to Social Research (≥2nd ed.). Oxford University Press. (Abbreviated “ASR” in preparation sheets)
• In German: Backhaus, K., Erichson, B., Plinke, W., & Weiber, R. 2010 (or newer). Multivariate Analyse¬methoden: Eine anwendungsorientierte Einführung (≥13th ed.). Berlin: Springer.
• Salkind, N.J. 2008 (or newer)). Statistics for people who think they hate statistics (≥ 3rd ed.). Thousand Oaks, CA: Sage.
• Hair, J. F., Jr., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. 2005 (or newer. Multivariate data analysis (≥6th ed.). Upper Saddle River, NJ: Prentice Hall.

Responsible for Module:
Förderer, Jens; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WIHN0820: Marketing and Innovation Management | Marketing and Innovation Management

Version of module description: Gültig ab winterterm 2019/20

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The grading will be based on a written exam (120 min). By answering multiple choiche questions students have to show that they have understood and can apply models and concepts related to markets aspects of innovation and to the organization of the innovation process. The questions also asses whether students remember and understand marketing basics (including key terms, theories, frameworks, the use of marketing strategies and marketing mix instruments, and their interrelationship with core concepts in marketing). The questions may require calculations. Students may use a non-programmable calculator to do these calculations.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
Market aspects of innovation:
- Innovation: Examples and particularities,
- Innovation and the development of industries,
- Sources of innovation,
- Innovation strategy: Analysis of the market, technology and competition,
- Acquisition of technology: Market, cooperation and networks

Organizing the innovation process:
- The innovation process within the firm,
- R&D, production and marketing,
- Cooperation for innovation?

- Motivation and incentive systems,
- Promotors and champions,
- Roles in the innovation process,
- Opposition against innovation within the firm,
- Integrating customers into the innovation process,
- Measuring and controlling innovation.

Marketing management:
- Principles of marketing,
- Marketing strategy and environment,
- Creating customer value, satisfaction, and loyalty,
- Information management and market research,
- Analyzing consumer and business markets,
- Competition and differentiation from competitors,
- Segmenting, targeting, and positioning,
- Creating and managing products and services, brand management,
- Pricing,
- Marketing communications, marketing channels, and service P's.

Intended Learning Outcomes:
At the end of the module, students will be able to (1) recognize and apply models and concepts related to the market aspects of innovation (e.g., modes of acquisition of technology) and to the organization of the innovation process (e.g., promotors and champions in the innovation process), (2) identify how they can be concretely used in companies, (3) remember and understand the key terms used in marketing, (4) explain common marketing theories and frameworks, (5) describe and justify the use of both marketing strategies and marketing mix instruments, and (6) relate the strategies and use of instruments to core concepts in marketing, such as customer lifetime value, segmenting, targeting, and positioning, decision making styles, customer-perceived value, satisfaction, and loyalty, as well as branding.

Teaching and Learning Methods:
The module consists of two lectures including one or two sessions held by guest speakers to refer to state of the art examples of marketing and innovation. Students will be motivated to read the literature before and after each lecture and relate it to the content taught in class. Furthermore, they will be motivated to discuss the content in online forums that are made available to the students.

Media:
Lecture slides are available via Moodle. Presentation slides, online discussion forum

Reading List:
• Hauschildt, Kirchmann - Teamwork for innovation - the ""troika"" of promotors
• Kotler/Keller/Brady/Goldman/Hansen (2012): Marketing Management, 2nd European ed., Pearson: Harlow.

• Kotler/Armstrong (2014): Principles of Marketing, 15th ed., Pearson: Harlow.
• Homburg (2015): Marketingmanagement. Strategie – Instrumente – Umsetzung – Unternehmensführung, 5. Aufl., Gabler: Wiesbaden.

Responsible for Module:
Lude, Maximilian; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WIHN1057_E: Cost Accounting | Cost Accounting

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The grading is based on a written exam (60 minutes). Students are allowed to use a non-programmable calculator for the exam. The students answer questions about definitions of cost accounting and about the basic principles of cost accounting. They further answer theoretical questions about concepts of cost accounting and their application. In a second part of the exam they have to apply the concepts to exemplary problems of cost accounting and are asked to perform the methods of cost accounting. Finally, they answer questions about the interpretation of their results.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:

The course introduces students to managerial cost accounting.
These are:
- cost type accounting (especially the different techniques to register the cost types of material and personnel costs)
- the assignment and allocation of indirect costs to the various cost centers
- the assignment of the determined costs to the individual products by using different techniques of product costing
- calculations of the operating result of the period
- systems of managerial cost accounting (cost planning and cost analysis)
- break even analysis

Intended Learning Outcomes:

After having attended this module, students will be able to remember and understand the basic concepts of managerial cost accounting systems. They will be able to analyze accounting problems and identify solutions. They will also be able to explain how managerial cost accounting support decision-making in a company. They will be able to apply the newly acquired knowledge to solve real-world accounting problems. They will be able to compare different concepts of managerial cost accounting such as variable vs absorption costing.

Teaching and Learning Methods:

The course consists of a lecture and an exercise. During the lectures the contents are delivered by presentations and discussions. The students are inspired to improve the acquired knowledge by studying the suggested literature. In the exercises the students apply the acquired knowledge in solving problem sets and implementing case studies.

Media:

presentations, text books, lecture notes, exercises

Reading List:
Friedl, Gunther; Hofmann, Christian; Pedell, Burkhard: Kostenrechnung - Eine entscheidungsorientierte Einführung, 2nd edition, München 2013.
Küpper, Hans-Ulrich; Friedl, Gunther; Hofmann, Christian; Pedell, Burkhard: Übungsbuch zur Kosten- und Erlösrechnung, 6th edition,
München 2010.

Responsible for Module:
Stich, Michael; Prof. Dr. rer. oec.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WIHN1058: Foundations of Entrepreneurial & Ethical Business | Foundations of Entrepreneurial & Ethical Business

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The grading is based on a written exam (120 Minutes). The written form of the exam allows a comprehensive assessment of students' knowledge and understanding of the basic principles of entrepreneurship. They will answer questions about the concepts explaining the mindset of entrepreneurial individuals and the management of entrepreneurial firms as introduced in the lecture. They will also answer questions about basic definitions of specific types of entrepreneurship and entrepreneurial behavior. The exams allows for a comprehensive evaluation of students' knowledge of basic principals and models of business ethics and their ability to further develop their knowledge of entrepreneurship. Students will answer questions about basic definitions and theories of ethical behavior and decision making, and they will assess ethical behavior in the business context.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
The module introduces students into basic principles of the topic of entrepreneurship from a global and international perspective. Students will be equiped with basic knowledge on:
- definitions, regional aspects, and special forms of entrepreneurship
- entrepreneurial individuals, including their personality, creativity, idea development, cognition, opportunity recognition, decision making, affect, and moving forward from failure
- entrepreneurial firms, including their growth strategies, strategic alliances, and resources.
Beyond that, students will engage in break-out group workshops to personally experience the process of opportunity recognition and development. In these workshops they will work in teams

and apply concepts from academic literature to real-world entrepreneurial problems. Furthermore, students give presentations to the audience and discuss their results.
In addition, the module introduces basic problems, arguments, and theoretical appoaches of business ethics. It investigates the chances of realizing moral norms at the interception of entrepreneurship/economics and ethics. Basic is the analysis of ethical decision processes in corporations and the detailed investigation of situations and alternatives of action. Topics involve reputation, trust and social capital as well es corruption, environmental protection, and global ethical concepts. This part ends with a critical discussion of different research approaches in the debate on business ethics.

Intended Learning Outcomes:
First, students will know and be able to explain basic concepts of entrepreneurship including basic definitions, psychological processes and characteristics of the person of the entrepreneur, and potential development paths of young firms. Further, students will transfer this basic knowledge to real world cases. Thus, students will be able to solve entrepreneurial problems in real world settings drawing on theoretical frameworks of the entrepreneurial process.
Students will be able to understand the ethical meaning of economic theories, reflect on ethical matters in business, and apply ethical theories in entrepreneurship and business settings. Thus, students will be able to decide in ethical manners in entrepreneurial and business life drawing on established ethical theories and concepts.

Teaching and Learning Methods:
The module will combine several learning methods.
- The basic knowledge as well as real world examples will be provided through the lecture.
- Discussions in the lecture and active participation are encouraged and will contribute to deepen the understanding of the concepts introduced.
- Workshops in smaller groups enable the students to apply (part of) their theoretical knowledge to real-world problems. This format additionally fosters creativity and team work.
- Students will get additional background knowledge from the scientific literature in private reading.

Media:
Presentations, exercises, online materials

Reading List:
Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2010). Entrepreneurship (8th ed.). New York: McGraw-Hill.
Read, S., Sarasvathy, S., Dew, N., Wiltbank, R. & Ohlsson, A.-V. (2010). Effectual Entrepreneurship. New York: Routledge Chapman & Hall.
Karl Homann/Christoph Lütge: Einführung in die Wirtschaftsethik,2. Aufl., Münster 2005.
Andrew Crane/Dirk

Matten: BusinessEthics: A European Perspective, Oxford 2003.
Karl Homann/Franz Blome-Drees: Wirtschaftsund
Unternehmensethik, Göttingen 1992

Responsible for Module:
Bird, Miriam; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WIHN1059_E: Financial Accounting | Financial Accounting

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination of the students' success consists of a written exam (120 min, multiple choice). If the number of participants is low, it is also possible to substitute the written exam by an oral exam (15 min). Students may use a non-programmable calculator and International Financial Reporting Standards as helping material . In the exam students show that they are able to correctly conduct individual financial statements, understand consolidated financial statements and apply consolidation principles as well as understand and apply balance sheet policy and analysis. This is done by means of conducting consolidations, and by solving arithmetic problems as well as theoretical problems regarding financial statements.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
The course gives an overview over basic financial accounting according to International Financial Reporting Standards (IFRS), focussing on regulations regarding commercial accounting in individual and consolidated financial statements.
In the first part of the lecture basic principles of financial accounting are introduced, dealing with general economic accounting and special financial accounting.
In the second part individual financial statements are explained and regulations for annual accounts and annual reports are discussed in detail.
In the third part methods of financial statement analysis are introduced and discussed.

Intended Learning Outcomes:
Upon successful completion of this module, students are able to understand the construction of individual and consolidated financial statements according to International Financial Reporting Standards (IFRS) and to apply the accounting regulations of the IFRS practically.
Students are also able to evaluate which enterprises have to prepare consolidated financial statements and which subsidiaries have to be included. Furthermore, they can independently carry out different consolidations correctly.

Teaching and Learning Methods:
The course consists of a lecture and a corresponding tutorial, which is integrated into the lecture. In the tutorial the content of the lecture and its understanding is deepened and extended by exercises and case studies. Relevant scripts and exercises can be downloaded via Moodle.
The lectures content is conveyed by means of presentation, while in the tutorial parts students can practise how to apply theoretical concepts practically.

Media:
Script, case studies, moodle

Reading List:
Internationale Rechnungslegung (Pellens/Fülbier/Gassen/Sellhorn)

Responsible for Module:
Stich, Michael; Prof. Dr. rer. oec.

Courses (Type of course, Weekly hours per semester), Instructor:
Financial Accounting (WIHN1059_E), (BMT Campus Heilbronn) (Vorlesung mit integrierten Übungen, 4 SWS)
Stich M
For further information in this module, please click campus.tum.de or here.

Module Description

WIHN1060: Production and Logistics | Production and Logistics

Version of module description: Gültig ab winterterm 2019/20

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination of the module consists of an exam (written, 120 minutes). Allowed aid is a non-programmable calculator.

In the exam students show that they can apply different approaches to problem solving - based on the understanding of the production and logistics planning in general. By means of exemplary objects from the production or logistics planning the students demonstrate that they can interpret planning problems and connections between different problems. Based on this knowledge students give recommendations to tackle the problems.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
None

Content:
This is an introductory module, providing an overview on planning problems in production and logistics and on methods to solve these. Students become acquainted with different planning hierarchies (strategic, tactical and operational) and the planning problems on the respective level. In order to deal with the arising decision problems in production and logistics simple heuristics as well as simple linear programming and mixed integer programming models are discussed and applied.

Contents are:
• strategic planning problems such as site location planning
• tactical planning level: infrastructure of production systems

• operational planning decisions: demand forecasting techniques and examine master planning problems.
• material requirements planning
• production planning: lot sizing questions, machine scheduling and sequencing in flow lines
• transport logistics: planning problems on the determination of tours, routes and packing schemes
• material logistics: inventory control policies and their extension to the stochastic case are elaborated
• strategic design of the logistics network
• interfaces to the predecessor resp. successor companies
• procurement stage: methods for the selection of suppliers
• distribution stage: installment of a suitable distribution network and the processes in the warehouse

Intended Learning Outcomes:
After participating in this introductory module, students will be able to
- understand the relation between different planning problems in production and logistics
- analyse specific planning problems of the strategic, tactical and operational level (for details see course content), as well as on how to apply respective solution approaches
- explain essential managerial tasks in production and logistics planning
- evaluate the economic impact of production and logistics related decisions (e.g. the tradeoff between holding and setup costs or between costs and service)

Teaching and Learning Methods:
The learning methods consist of lectures, (voluntary) tutorials and further literature.
The lectures are used to convey the theoretical foundation and include conducting exercises.
The tutorials accompany the lectures and deepen their content in an environment of small student groups. Students solve exercises on their own for most of the time and sometimes in group work.
During the lecture, further readings are suggested, to get a deeper understanding of the course content.

Media:
Presentations, Script (Produktionsmanagement)

Reading List:
Günther, H.O., Tempelmeier, H. (2012), Produktion und Logistik, 9. Auflage, Springer

Responsible for Module:
Wuttke, David; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WIHN1121: Strategic and International Management & Organizational Behavior | Strategic and International Management & Organizational Behavior

Version of module description: Gültig ab summerterm 2019

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 60	**Self-study Hours:** 180	**Contact Hours:** 120

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Grading is based on the performance in a 120min written examination. The examination consists of single-choice-questions, which aim at testing knowledge on different levels: Knowledge questions aim at the recall of the learned concepts, e.g. by reproducing different change management models; decision items aim at classifying or interpreting the module contents, e.g. by contrasting and comparative analysis of different strategies of multinational enterprises; application and scenario questions aim at testing the ability to transfer the learned concepts to real-life settings, e.g. by identifying solutions to short practical cases in conflict management. It is allowed to bring one hard-copy dictionary (English – first language) or English thesaurus. Furthermore, no aids such as lecture slides, personal notes, etc. are allowed.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics of business administration

Content:
According to the intended learning outcomes of this module, the lectures cover the most important theories and methods of strategic and international management and organizational psychology. In the course of the increasing globalization, companies of almost all industries and sizes have to include an international dimension in their strategic considerations. Strategic and international management skills are important for formulating and implementing competitive strategies. Therefore, the module puts special emphasis on strategic and international management topics. Furthermore, basic approaches and models of work and organizational psychology are presented. They serve to understand behavior on the individual, team, and organizational level of business

organizations. In detail, the module will focus on theoretical explanations and practical implications of the following contents:
- Fundamental principles of leadership;
- fundamentals and characteristics of strategic and international management;
- general conditions of strategic and international management;
- effects of individual personality characteristics and motivation in organizations;
- ethical behavior in organizations;
- team structures and processes;
- change management in national and international organizations;
- theories and strategies of multinational enterprises;
- international dimension of certain functional areas of business;
- national and international organizational culture.

Intended Learning Outcomes:
Upon successful completion of this module, students are able to reproduce basic knowledge of strategic and international management and organizational behavior. Moreover, students can recall, understand, and explain basic concepts of strategic and international management and organizational behavior. They can apply their knowledge to practical problems and challenges. Furthermore, students are able to explain theories, models, and methods related to strategic and international management and organizational behavior. In addition, students are able to identify and analyze challenges and problems related to strategy and management, motivation, teamwork, decision making, and communication in business organizations, especially in multinational enterprises. Finally, they are able to outline practical solutions to strategy and management challenges, conflict management, organizational change, and ethical issues by applying the acquired theoretical concepts.

Teaching and Learning Methods:
In the interactive as well as online video-based lectures, the most important concepts, approaches, theories, and empirical studies in the field of strategic and international management and organizational behavior are introduced and discussed. Practical examples and case studies serve to illustrate the relevant theories and methods. Moreover, students are encouraged to engage in individual exercises and/or small group assignments during the lectures as well as video analyses in order to look deeper into the course contents and to support transfer of the acquired theories and methods. Finally, the self-study of literature is part of the module.
As part of the module, students are able to participate in two 60-120 min long psychological studies/psychological experiments as a mid-term examination. Participation is voluntary and can, in accordance to APSO regulations, be used to improve the grade on the final exam.
This mid-term examination illustrates parts of the learning content and allows students to gain experience with scientific (psychological) methodology. Available experiments are listed on http://motivatum.wi.tum.de/EN/.

Media:
Slides (download)
Online video lectures (download)

if applicable, present scientific international literature (English)
if applicable, case studies

Reading List:
Cavusgil, S.T., Knight, G., Riesenberger, J. R. (2008), International Business: strategy, management, and the new realities
Hill, C.W.L. (2014), International business: Competing in the Global Marketplace
Landy, F.J., & Conte, J.M. (2013). Work in the 21st century. Hoboken, NJ: Wiley.
Wood, J. M. (2016). Organisational behavior: Core concepts and applications. Milton, Australia: Wiley.

Responsible for Module:
Dlouhy, Katja; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Strategic and International Management & Organizational Behavior – BMT Heilbronn (WIHN1121) - Additional Exercise (Übung, 1 SWS)
Dlouhy K
For further information in this module, please click campus.tum.de or here.

Basics in Economics | Basics in Economics

Module Description

WIHN0023_E: Economics II - Macroeconomics | Economics II - Macroeconomics [VWL 2]

Macroeconomics

Version of module description: Gültig ab winterterm 2020/21

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The exam will be a written test (120 min.) at the end of the term. The exam is designed to assess the participants' capabilities to apply macroeconomic theory in order to discuss and solve real world problems of the economy as a whole. Participants should demonstrate their capacity for abstraction (thinking in economic models), concretization (calculating, interpreting and applying the results of the model, mathematical processing as well as graphical illustration.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
no specific prerequisites

Content:
This module provides an introduction to basic concepts of macroeconomics. It covers:
- key institutions of capitalism as an economic system (private property, firms, markets)
- technological change as a trigger for economic growth
- price-taking and competitive markets
- price-setting, rent-seeking and market disequilibuium
- market successes and failures
- markets, contracts and information
- credit, banks and money
- economic fluctuations and unemployment
- unemployment, inflation, fiscal and monetary policy

- technological progress and living standards
- the Great Depression, the golden age of capitalism and the global financial crisis

Intended Learning Outcomes:
After attending the module, students will able to describe the composition and distribution of the Gross Domestic Product. They can analyze the economic mechanisms underlying unemployment as well as issues regarding monetary policy and inflation. Further, participants will learn to understand the economic crisis and the wealth differences among nations. Students are enabled to think in models and apply mathematical solutions when approaching economic problems.

Teaching and Learning Methods:
The module consists of a lecture and an exercise course. The lecture content will be delivered in a verbal presentation with the help of slides. Since the foundation of the lecture is a textbook including recent economic history, the teaching is full of real life examples. The content of the lecture is put into practice in the exercise course which applies the theoretical knowledge by basic mathematical calculations and graphical illustrations. Therefore, the module aims at encouraging participants to independently think about economic problems discussed in the lecture and in the current literature. Students are enabled to use the instruments (abstract and model thinking) for operationalizing economic problems and solve them in the conventional, mathematical manner.

Media:
http://www.core-econ.org/

Reading List:
The CORE Project (2016): 'The Economy', in: Azm Premji University, Friends Provident Foundation, HM Treasury, Institute for New Economic Thinking, Open Society Foundations, SciencesPo, UCL (eds.), University College London.

Responsible for Module:
Lergetporer, Philipp; Prof. Ph.D.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Basics in Law | Basics in Law

Module Description

WIHN1119: Business Law I | Business Law I [BusLaw]

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:

In the final assessment students will need to demonstrate to what extent they have met the Learning Objectives. This assessment will be held as a written exam of 120 minutes in which students are allowed to use the applicable statutory law. The exam consists of two parts which form the overall mark together.
In the first part, students will be asked theoretical questions. This will demonstrate to what extent they have memorised and understood principles of the law of contracts (formation, discharge, and liability), torts, and company law under German, European and Common Law. Students will also be asked to apply their knowledge to known and fictional cases. This second part demonstrates if students have developed the required legal analytical skills. Students also need to demonstrate their ability to apply their knowledge to fact settings not discussed in the lecture, and to evaluate the legal consequences.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
This module covers the legal essentials of running a business. It includes an overview of the legal framework in Germany and Europe, the formation and termination of contracts, selected types of contract (in particular, sale of goods), torts, property law, and company law. The module covers aspects of the German legal framework as well as the common law. This module is a prerequisite for "Business Law 2". It cannot be replaced with "Wirtschaftsprivatrecht 1".

Intended Learning Outcomes:
At the end of this module students will be able
(1.) to name and understand the rules and principles of both German business law and the common law which are most important for businesses,
(2.) to grasp and apply the legal principles regulating business activity, in particular regarding liability under tort, contract and company law;
(3.) to analyse legal implications of typical business situations and to identify their options;
(4.) to present the results of their analysis in a written analysis.

Teaching and Learning Methods:

The lecture will cover the theoretical aspects of the module in a discussion with the lecturer. The tutorial will focus on case studies. It will provide the opportunity to work individually or in groups on case scenarios (known and unknown), covering various issues of German and the common law. The purpose is to repeat and to intensify the content discussed in the lecture and to review and evaluate legal issues from different areas of law in everyday situations. Students will develop the ability to present these findings in a concise and well-structured written analysis.

Media:
Reader, Presentations (PPT), Cases

Reading List:

Robbers, An Introduction to German Law (6th ed., 2017)

Responsible for Module:
Jung, Stefanie; Prof. Dr. jur.

Courses (Type of course, Weekly hours per semester), Instructor:
Business Law I - Exercise (BMT Campus Heilbronn) (Übung, 2 SWS)
Dowse M, Haag A

Business Law I (BMT Campus Heilbronn) (Vorlesung, 2 SWS)
Reger G
For further information in this module, please click campus.tum.de or here.

Module Description

WIHN1120: Business Law II | Business Law II [BusLaw2]

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In the final assessment students will need to demonstrate to what extent they have met the Learning Objectives. This assessment will be held as a written exam of 120 minutes.
In this exam students will be asked theoretical questions. This will demonstrate to what extent they have memorised and understood principles of EU law. Students will also be asked to apply their knowledge of EU law to known and fictional cases. This demonstrates if students have developed the required legal analytical skills. Students also need to demonstrate their ability to apply their knowledge to fact settings not discussed in the lecture, and to evaluate the legal consequences.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Recommended: Attendance of WI001119 Introduction to Business Law.

Content:

This module provides on overview of the laws of the European Union that are relevant for national and international businesses.
Topics covered are the oncept of internal market & 5 freedoms, the EURO, EU trade law, EU company and securities laws, EU competition law & state aids, EU IP & licensing agreements.

Intended Learning Outcomes:
At the end of this module students will be able
(1.) to name and understand the rules and principles of EU law which are most important for businesses,

(2.) to grasp and explain the framework of EU economic policies, in particular the interaction between EU law and member state law,
(3.) to identify and analyse restrains prescribed by EU law from the perspective of businesses and employees,
(4.) to assess real life scenarios regarding their EU law implications.

Teaching and Learning Methods:

The module will cover the theoretical aspects of EU law in a discussion with the lecturer. It will also provide the opportunity to work individually or in groups on case scenarios covering issues of EU law. The purpose is to repeat and to intensify the content discussed in the lecture and to review and evaluate legal issues. Students will develop the ability to present these findings in a concise and well-structured analysis.

Media:
Reader, Presentations (PPT), Cases

Reading List:

Schütze, An Introduction to European Law (2012); Chalmers/Davies/Monti, European Union Law (3rd ed., 2014)

Responsible for Module:
Jung, Stefanie; Prof. Dr. jur.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Specialization in Technology | Specialization in Technology

Specialization in Technology: Digital Technologies | Specialization in Technology: Digital Technologies

If students choose the specialization in Digital Technologies, they must earn all required modules and 12 credits from a project work.

Required Modules: Digital Technologies | Required Modules: Digital Technologies

Module Description

EI10007: Principles of Information Engineering | Principles of Information Engineering

Version of module description: Gültig ab winterterm 2019/20

Module Level:	Language: English	Duration: one semester	Frequency: winter semester
Credits:* 5	Total Hours: 150	Self-study Hours: 105	Contact Hours: 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module examination is based on a written exam (75 minutes) which contains questions to asses the students' knowledge about the technical systems and their theoretical background, short mathematical problems to assess the students' mastering of the practiced mathematical concepts, and conceptual questions (e.g., about design principles or fundamental limitations) to assess the further intended learning outcomes. Up to 20% of the examination can be conducted in the form of multiple choice questions.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
The following module should be successfully completed prior to participation: MA9711 Mathematics in Natural and Economic Science 1.
The following module is recommended to be attended in parallel (if not already attended earlier): MA9712 Statistics for BWL.

Content:
* Fundamentals:
- Elements of Stochastic Modeling and Analysis
- Signals (analog/digital, deterministic/stochastic, real/complex)
- The Frequency Domain (Fourier transform, spectrum and bandwidth, sampling theorem)
- Information Theory (fundamentals, source coding, channel coding, channel capacity)
* Information Transmission and Storage Systems:

- Elements of Data Transmission (transmission chain, filtering, modulation, detection)
- Communication Systems (real systems compared to theory, channel models, performance criteria, comparison to data storage, current trends)
- Communication Networks (network structures, interference, broadcast and multiple access, multihop and relaying, abstraction layers, network planning)
* Elements of Information Processing
- Data Processing Devices (abstraction layers, real systems compared to theory, digital processing, algorithms and complexity)
- Data Acquisition (sampling and quantization, information and noise modeling)

Intended Learning Outcomes:
After attending the module, the students:
- can describe the main principles of operation of information transmission systems and networks as well as of data processing devices
- are familiar with fundamental design principles of such systems and understand why existing systems are designed the way they are
- have an overview of the underlying physical and mathematical principles and can distinguish fundamental limitations from technological constraints
- have learned to take an engineering perspective on information transmission and processing tasks (e.g., by structuring a system into building blocks and abstraction layers)
- know the main mathematical methods relevant for this field of engineering and are able to apply a selection of these methods to example problems

Teaching and Learning Methods:
The module is designed for non-engineering students (in particular students in Management and Technology) who aim at understanding the fundamental principles and concepts of modern information transmission and processing. It consists of lectures, exercise courses, and self-study.

In the lectures, both theoretical backgrounds and technical implementations are introduced and discussed. Mathematical concepts are introduced and explained as far as it is necessary for understanding the technical systems. The relevance of each of the considered topics is motivated by, e.g., press articles, teaser questions, or examples from daily life, and an additional reflexion at the end of each topic unit aims at conveying the engineering perspective on the considered problems and systems. New concepts are presented in a teacher-centered style and discussed in an interactive manner.

The aim of the exercise courses is to repeatedly practice the application of the mathematical concepts as well as the ability to answer conceptual questions about the subject. The exercise courses are held in a student-centered way, and problem sheets are provided.

Throughout the semester, short reading assignments may be given to the students, e.g., as an introduction to a new topic. In addition, the students are expected to recapitulate the lecture contents and to individually practice the exercises.

Media:
- Slide Presentations
- Blackboard (e.g., for mathematical details)
- Supporting documents (e.g., news articles, scientific publications) as downloads (reading assignments)
- Problem sheets as downloads

Reading List:
Since text books on the topics covered in the course are designed for a different target audience (engineering students), it is recommended to rely on the learning material provided during the course instead of on text books. However, students who are interested in more mathematical and technical details may refer to the corresponding sections in, e.g., the following text books.
- Bruce Hajek, "Random Processes for Engineers," Cambridge University Press, 2015.
- John G. Proakis and Dimitris G. Manolakis: "Digital Signal Processing. Principles, Algorithms, and Applications," Pearson Prentice Hall, 4th ed., 2007.
- Thomas M. Cover and Joy A. Thomas, "Elements of Information Theory," 2nd ed. Hoboken, NJ: Wiley- Interscience, 2006.
- Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005.
- David A. Patterson and John L. Hennessy, "Computer Organization and Design. The Hardware / Software Interface," Elsevier/Morgan Kaufman, 5th ed., 2014.

Responsible for Module:
Utschick, Wolfgang; Prof. Dr.-Ing.

Courses (Type of course, Weekly hours per semester), Instructor:
Principles of Information Engineering (Vorlesung mit integrierten Übungen, 3 SWS)
Jedda H, Utschick W
For further information in this module, please click campus.tum.de or here.

Module Description

EI10008: Machine Learning and Data Science | Machine Learning and Data Science [MLDS]

Version of module description: Gültig ab winterterm 2019/20

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module examination is based on a written exam (60 minutes) which contains questions to assess the students' knowledge about the technical systems and their theoretical background, short mathematical problems to assess the students' mastering of the practiced mathematical concepts, and conceptual questions (e.g., about design principles or fundamental limitations) to assess the further intended learning outcomes. Up to 20% of the examination can be conducted in the form of multiple choice questions.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge of linear algebra and statistics.

The following module should be successfully completed prior to participation:
MA9711 Mathematics in Natural and Economic Science 1.

The following modules are recommended to be attended in parallel (if not already attended):
MA9712 Statistics for BWL,
EI10007 Principles of Information Engineering.

Content:
- Paradigms in data preparation
- Curse of dimensionality
- Supervised and unsupervised learning
- Principal component analysis
- Clustering algorithms

- Classification methods
- Regression methods
- Learning and generalization
- Deep neural networks

Intended Learning Outcomes:
After attending the module, the students:
- can describe the main principles of how to retrieve information out of a huge amount of data and to reduce its dimension in an intelligent way
- are familiar with fundamental design principles of such methods and understand why existing algorithms are designed the way they are
- understand the principles of widespread machine learning techniques in general and have an overview of the underlying mathematical principles
- understand the fundamentals of deep convolutional networks and how to apply them on practical applications

Teaching and Learning Methods:
The module is designed for non-engineering students (in particular students in Management and Technology) who aim at understanding the fundamental principles and concepts of modern information transmission and processing. It consists of lectures, exercise courses, and self-study. In the lectures, both theoretical backgrounds and technical implementations are introduced and discussed. Mathematical concepts are introduced and explained as far as it is necessary for understanding the technical systems. The relevance of each of the considered topics is motivated by, e.g., press articles, teaser questions, or examples from daily life, and an additional reflection at the end of each topic of what has been learned aims at conveying the engineering perspective on the considered problems and systems. New concepts are presented in a teacher-centered style and discussed in an interactive manner. The aim of the exercise courses is to repeatedly practice the application of the mathematical concepts as well as the ability to answer conceptual questions about the subject. The exercise courses are held in a student-centered way, and problem sheets are provided. Throughout the semester, short reading assignments may be given to the students, e.g., as an introduction to a new topic. In addition, the students are expected to recapitulate the lecture contents and to individually practice the exercises.

Media:
- Slide Presentations
- Blackboard (e.g., for mathematical details)
- Supporting documents (e.g., news articles, scientific publications) as downloads (reading assignments)
- Problem sheets as downloads

Reading List:
- Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning, MIT Press 2016
- Sergios Theodoridis. Machine Learning, A Bayesian and Optimization Perspective, Elsevier 2015
- Kevin P. Murphy. Machine Learning, A Probabilistic Perspective, MIT Press 2012

- Richard O. Duda, Peter E. Hart, and David G. Stork. Pattern Classification, John Wiley 2001
- T. Hastie, R. Tibshirani, J. Friedman: The Elements of Statistical Learning, Springer 2009.
- Charu C. Aggarwal: Data Mining, Springer 2015

Responsible for Module:
Utschick, Wolfgang; Prof. Dr.-Ing.

Courses (Type of course, Weekly hours per semester), Instructor:
Machine Learning and Data Science (Vorlesung mit integrierten Übungen, 3 SWS)
Utschick W, Fesl B
For further information in this module, please click campus.tum.de or here.

Module Description

IN8005: Introduction into Computer Science (for non Informatics studies) | Einführung in die Informatik für andere Fachrichtungen

Version of module description: Gültig ab summerterm 2015

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Type of Assessment: written exam (90 minutes)
The exam takes the form of written test. Knowledge questions allow to assess acquaintance with and understanding of the basic concepts of Computer Science. Small programming and modelling problems allow to assess the ability to practically apply the learned programming- and query-languages and modelling-techniques for the solution of small problems.
Homework will be scored and upon achieving a minimum equired number of points, a 0,3 bonus for the final grade is granted.

In case of epidemiologic emergencies, the exam may be substituted by a graded electronic exercise or a proctered exam.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Recommended requirements are Mathematics modules of the first year of the TUM-BWL bachelor's program as well as the module WI000275 'Management Science'.

Content:
The module IN8005 is concerned with topics such as:
- Database Management Systems,.ER models, Relational Algebra, SQL
- Java as a programming language:
++ basic constructs of imperative programming (if, while, for, arrays etc.)
++ object-oriented programming (inheritance, interfaces, polymorphism etc.)
++ basics of Exception Handling and Generics
++ code conventions

++ Java class library
- Basic algorithms and data structures:
++ algorithm concept, complexity
++ data structures for sequences (arrays, doubly linked lists, stacks & queues)
++ recursion
++ hashing (chaining, probing)
++ searching (binary search, balanced search trees)
++ sorting (Insertion-Sort, Selection-Sort, Merge-Sort)

Intended Learning Outcomes:
Upon successful completion of the module, participants understand important foundations, concepts and ways of thinking of Computer Science, in particular object-oriented programming, databases and SQL, and basic algorithms and data structures, have an overview over these topics and be able use them for the development of own programs with a link to a database in a basic way.

Teaching and Learning Methods:
Lecture and practical tutorial assignments. A central tutorial deepens the understanding of the concepts introduced in the lecture using example assignments in regard to being able to solve given problems. In the tutorials, the students solve basic assignments under intensive supervision, which contributes to providing them with the basic skills in programming, in order to be able to apply the knowledge acquired by self-study of the accompanying materials of lecture and central tutorial for autonomously solving the programming assignments of the homework. During the second half of the semester, the students work on a small practical project, which aims at deepening the connected understanding of the desired learning outcomes. Programming aspects of this project are distributed over tutorial and homework assignments and are aligned with the topics of the respective week.

Media:
Slides, blackboard, lecture- and central tutorial recording, discussion boards in suitable e-learning platforms

Reading List:
Chapters from textbooks, which are closely associated with the module content and are provided to the students online.

Responsible for Module:
Seidl, Helmut; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Einführung in die Informatik für andere Fachrichtungen (TUM BWL) (IN8005) (Vorlesung, 2 SWS) Groh G

Übung zur Einführung in die Informatik für andere Fachrichtungen (TUM BWL) (IN8005) (Übung, 2 SWS)
Groh G [L], Dall'Olio G, Groh G, Steinberger C
For further information in this module, please click campus.tum.de or here.

Module Description

IN8027: Introduction to Informatics for Students of Management & Technology – Programming Lab Course | Introduction to Informatics for Students of Management & Technology – Programming Lab Course

Version of module description: Gültig ab winterterm 2018/19

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 120	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Type of assessment: individual grading of submitted written exercise work ("Übungsleistung / sonstige schriftliche Leistung" according to TUM-APSO): short project reports and project artefacts (code, software engineering process documents (e.g. UML diagrams) etc.).
During the four-week block period, students submit their intermediate and final work results (especially including their written program-code and documents of the software engineering process) electronically via a revision control system (usually GIT). Furthermore, at the end of the block period, each student submits a small, concise project report, in which her individual contributions to the work results are described.
The submitted written exercise work documents the student's degree of acquaintance with the programming language Java and their practical skills in terms of programming in the small and allows to assess how well the students are able to apply database-systems and SQL, basic object-oriented programming and Java, and basic algorithms and data structures for solving small to medium sized programming problems. The submitted exercise work also shows how well the participants are acquainted with and can apply the basics of a modern agile software development process.
Individual project reports, the documented submission history in the revision control environment, and the documents created in the structured software development process ensure that student contributions may be assessed on an individual basis.
The retake exam is offered in the form of a written exam (120 minutes, closed book) at the end of the semester.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
None.
Participants should attend the module IN8005: “Introduction to Informatics for Students of Management and Technology” in the same semester.

Content:
• Object-oriented software development with Java
• SQL integration in Java
• Agile software development processes (typically Scrum)
• Revision control systems (typically GIT)

Intended Learning Outcomes:
Upon successful completion of the module, participants are acquainted with the programming language Java and master programming in the small. Participants are able to apply the contents taught in the module IN8005 (foundations of database-systems and SQL, foundations of object-oriented programming and Java, foundations of algorithms and data structures) for solving small to medium sized programming problems in their professional field and/or for later scientific work. Participants are acquainted with and can apply the basics of a modern agile software development process (typically Scrum) for the development of solutions to these problems and are able to collaborate with informatics professionals in analyzing and evaluating the complexity of possible software solutions for professional problem settings.
Students are able to complete the tasks of their project in a team environment. They solve the given task by constructively and conceptually collaborating in a team. They are able to integrate involved persons into the various tasks considering the group situation. Furthermore, the students are able to conduct solution processes through constructively and conceptually acting in a team.

Teaching and Learning Methods:
The lab-course takes the form of a four-week block lab-course taking place in the second half of the semester. In the first half of the semester, the students learn the theoretical background for their work in this module in the module IN8005 (lecture and exercise course and voluntary tutor-exercises).
Students work in groups of five on a practical programming problem (typically from the field of management) using a small database. According to the software development process, regular group meetings and meetings with the teaching staff take place in which the progress is monitored and assistance is given.

Media:
slides, problem specification sheets, moderated discussion boards in suitable e-learning platforms, (software development environment), (group and tutor meetings).

Reading List:
• Learning Materials for IN8005 (continuously updated).
• S. Reges, M.Stepp: Building Java Programs: A Back to Basics Approach, Pearson 2014
• K. Rubin: Essential Scrum, Addison Wesley, 2012

Responsible for Module:
Groh, Georg; Apl. Prof. Dr. rer. nat. habil.

Courses (Type of course, Weekly hours per semester), Instructor:
Introduction to Informatics for Students of Management & Technology – Programming Lab Course (IN8027) (Praktikum, 2 SWS)
Groh G [L], Groh G
For further information in this module, please click campus.tum.de or here.

Module Description

MW2383: Design and Analysis of Digital Control Systems | Design und Analyse digitaler Steuerungssysteme

Version of module description: Gültig ab winterterm 2019/20

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module will be evaluated via an exercise consisting of lab tasks and assignments during the semester. The final grade will be calculated based on the sum of points collected in these exercises. Participation in the lab is therefore mandatory.
During the semester, students work on programming tasks that demonstrate that they can design and analyze time-sensitive software for cyber-physical applications and use low-level hardware features such as hardware timers, interrupts, pulse wide modulation (PWM), analog-to-digital, and digital-to-analog converters for microprocessor programming. This type of verification is necessary because only this practical application of methods and basic concepts (programming) can achieve the learning result.

Repeat Examination:

(Recommended) Prerequisites:
Would be nice to have IN8005 (Introduction to Computer Science for Economics Students) before or in parallel of this module

Content:
1. Development cycles of Digital Systems / of Cyber-Physical Systems
a. Similarities and differences compared to mechanical / physical systems/products
2. Risk management within project management
a. Applied to project management of DS / CPS development
b. Goal: understand why it is important, and why it can be costly
3. Why do we need models?
a. {Set of requirements} -> 1: Models of the Cyber parts, and 2: Models of the Physical parts -> Implementation of a Cyber-Physical System

b. Traceability
4. V-model of a development cycle, Verification, Validation and Testing phases (Part 1), Certification process and documentations
a. differences compared to mechanical / physical systems/products
b. critical systems: need for a certification
c. mainstream systems: mass customization, need for rapidly changing requirements
5. Modeling
a. SysML:
i. Multidisciplinary, high-level modeling tool
b. Matlab, Simulink:
i. Simulation tool
ii. Automatic code generation from a model
iii. Certification process: traceability, verification, testing, documentation
iv. Re-use of toolboxes
c. In parallel of Matlab examples, details about Verification, Validation and Testing (Part 2)
i. How does it work theoretical and why we need it
ii. How to use it in practice using Matlab toolboxes
6. Sensors and Actuators as the interface to Cyber-Physical Systems
a. Sensors and Actuators technology, datasheets
b. Interfaces, Network

Intended Learning Outcomes:
Upon successful completion of the module, the participants understand important concepts and methods required to model and analyze modern digital control systems.
The participants should remember the different phases of a software development and be able to identify and compare the exisiting methods to ensure the dependability of digital control systems.
The participants should be able to communicate with engineers in the field, and thus, they are able to describe the reasons of the cost and complexity involded in the development of dependable software.
In the context of a project development, the participants should be able to understand the principle of existing simple models in SysML and in Matlab Simulink, as well as being able to model themselves some simple applications.
The applications will focus on the development of software for cyber-physical systems (automotive, aerospace, robotics, ...).

Teaching and Learning Methods:
The module consists of a class lecture and of a project-oriented exercise.

The lecture will be used to introduce the new concepts illustrated and supported with beamer slides. This helps to impart basic knowledge and to help students understand different methods to model and analyze modern digital control systems.

Then, in order to demonstrate the practical relevance of the different concepts introduced and explained during the lecture, during the exercise, each student will be assigned to a group in

charge of a specific project. During this project-oriented exercise, the students will apply these concepts directly and would have the possibility to ask for more details whenever needed.
Thus, the students will learn by practicing how to understand existing simple models in SysML and in Matlab Simulink, as well as how to model a part of a systems and how to explain and classify costs and the complexity of software development.

Media:
Presentation slides, as well as annotations made during the lecture; Execises template and examples of solutions

Reading List:
Recommendations readings for each topic will be provided during the course.
E.g.
- Moskal, M., 2011, April. Verifying functional correctness of C programs with VCC. In NASA Formal Methods Symposium (pp. 56-57). Springer, Berlin, Heidelberg.
- Holzmann, G.J., 1997. The model checker SPIN. IEEE Transactions on software engineering, 23(5), pp.279-295.
- Zaytoon, J. and Lafortune, S., 2013. Overview of fault diagnosis methods for discrete event systems. Annual Reviews in Control, 37(2), pp.308-320.
- Zaytoon, J. and Riera, B., 2017. Synthesis and implementation of logic controllers–A review. Annual Reviews in Control, 43, pp.152-168.

Responsible for Module:
Caccamo, Marco; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Design and Analysis of Digital Control Systems (Vorlesung, 2 SWS)
Caccamo M, Cao H, Roy D

Tutorials on Design and Analysis of Digital Control Systems (Übung, 2 SWS)
Caccamo M, Cao H, Roy D, Trumpp R
For further information in this module, please click campus.tum.de or here.

Module Description

MW2468: Logistics Engineering in Production Systems and Supply Chain Management | Logistics Engineering in Production Systems and Supply Chain Management

Version of module description: Gültig ab winterterm 2018/19

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 45	**Contact Hours:** 105

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Students apply the lecture's contents in a written exam (duration: 90 minutes) with questions and calculation tasks. The only aid allowed is a non-programmable calculator. In this way, students demonstrate different abilities: to analyze logistics systems, logistics processes and logistics structures; to apply methods for planning of such structures; to understand the key functions of physical logistics.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
no

Content:
From a higher point of view, the module explains the main principles and goals of logistics engineering, as well as key indicators and impact factors of logistics. Technical processes are explained for a better understanding of production systems, distribution centers and material supply in production systems. Common structures of production and distribution are presented along with according control strategies and technologies. Besides key functions of material flow-transportation, distribution/consolidation, storage, order picking and handling-methods to model material flow systems are taught, e. g. flow charts, graphs, material flow matrices and layouts. Methods to analyze system behavior complete the module; they comprise static dimensioning, event-discrete simulation, emulation, queuing theory and the concept of availability and reliability of technical systems. Furthermore, we give an overview on how data can be available on different levels of logistics systems to enable smart factories.

Technologies for the operations in a smart factory are discussed, comprising control and design strategies (flow shop vs. job shop, modular factories, decentralized and autonomous controls), localization, identification and mobile robots.

Additionally, the module contains the following contents:
- Logistics systems: Design guidelines; logistical processes, functions, and structures; logistical networks; methods for planning logistical structures
- Logistics management: Control and coordination in logistics systems, information management

Intended Learning Outcomes:
Having completed the module, students know about key tasks and aims of logistics. They are able to analyze logistics systems, logistical processes and logistical structures. Furthermore, they can apply methods to plan logistical structures and know means of control and coordination in logistics systems and concepts of information management. They know a variety of technologies for smart factories along with their benefits and boundaries.

In addition, students understand the key functions of physical logistics and are able to apply methods to depict material flow and to dimension and evaluate logistics systems.

Teaching and Learning Methods:
Contents are explained by lectures and by exemplary applications from industrial practice. Supporting the lectures, students have access to a detailed collection of slides, exercises and sample solutions.
In tutorials, exercises demonstrate the applicability of the lectures' theoretical contents.
All documents and further information are accessible online and free via elearning. During office hours of scientific staff, individual questions and problems can be discussed.

Media:
Lectures: Talk with tablet and projector, board and overhead projector; printed scriptum (fee-based)
Online documents: Documents for exercises with sample solutions; scriptum (digital as PDF, free of charge)

Reading List:
Literature:
Aggteleky, B.: Fabrikplanung: Werksentwicklung und Betriebsrationalisierung, Band 1-3. München, Wien: Hanser 1987 (Band 1) und 1990 (Band 2 und 3)
Arnold, D.: Materialflusslehre. Braunschweig, Wiesbaden: Vieweg, 1998
Dangelmaier, W.: Fertigungsplanung. Düsseldorf: VDI-Verlag, 2001
Gudehus, T.: Logistik: Grundlagen, Strategien, Anwendungen. Berlin u.a.: Springer, 2005
Großeschallau, W.: Materialflussrechnung. Berlin u.a.: Springer, 1984
Kettner, H., Schmidt, J., Greim, H.-R.: Leitfaden der systematischen Fabrikplanung. München, Wien: Hanser, 1984
Jünemann, R.: Materialfluss und Logistik: Systemtechnische Grundlagen mit Praxisbeispielen. Berlin u.a.: Springer, 1998

Jünemann, R., Schmidt, T.: Materialflusssysteme: Systemtechnische Grundlagen. Berlin u.a.: Springer, 1999
Pfohl, H.-C.: Logistiksysteme: Betriebswirtschaftliche Grundlagen. Berlin u.a.: Springer, 2004
VDI-Gesellschaft Fördertechnik Materialfluss Logistik (Hrsg.). VDI-Handbuch Materialfluss und Fördertechnik: Band 1 8. Düsseldorf: VDI-Verlag
Wildemann, H.: Logistik Prozessmanagement. München: TCW Transfer-Centrum, 2005
Wiendahl, H.-P.: Fertigungsregelung: Logistische Beherrschung von Fertigungsabläufen auf Basis des Trichtermodells. München, Wien: Hanser, 1997

Responsible for Module:
Professor Dr.-Ing. Johannes Fottner: fottner@fml.mw.tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Logistics Engineering in Production Systems and Supply Chain Management (Vorlesung, 2 SWS)
Haid C [L], Fottner J

Logistics Engineering in Production Systems and Supply Chain Management (Übung, 2 SWS)
Haid C [L], Fottner J
For further information in this module, please click campus.tum.de or here.

Elective Modules: Digital Technologies | Elective Modules: Digital Technologies

Module Description

EI10009: Project Work in Electrical Engineering and Information Technology (EI) | Project Work in Electrical Engineering and Information Technology (EI)

Version of module description: Gültig ab winterterm 2019/20

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 12	**Total Hours:** 360	**Self-study Hours:** 330	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module grade is based on a research paper (6-8 pages in IEEE double column conference format) and a presentation (20 minutes).
The research paper summarizes the results of the project work until the end of the semester.
By writing the research paper, students show their ability to work and write scientifically. In the research paper students demonstrate that they are able to apply knowledge and methods within a research project in the field of Computer Engineering They show that they can work out important questions related to the research problem.
At the end of the lecture period, participants give a 20-minute talk summarizing their results.
Students show their ability to present their results in a structured and comprehensible manner.
Moreover, they demonstrate that they are able to respond competently to questions related to their topic. Each team member should contribute to the presentation.
At the end of the semester students have to hand in a declaration, which summarizes the exact contributions for each team member (for the research paper, for the written code, for the conducted evaluation experiments, or for other products and activities of the research project).
Additionally, regular supervision meetings with the supervisor and advisors and the project report ensure that student contributions may be assessed on an individual basis. The team members' individual project contributions and submitted work is graded by the supervisor.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
The project work is centered around a research question in the field of work of the supervisor and the advisor (typically a doctoral student). Students experience hands-on work in a project, where they work together in teams. They pass through the whole process of a small scientific project. The content depends on the research question and the elements of scientific project work.
Example content: The project work of the student team may consist in systematically evaluating a case study of artificial intelligence and data science in focus groups. The contents of the module then encompass quantitative and qualitative evaluation methods, content elements of the theoretical background of the research question / research field (e.g. paradigms in data preparation, supervised and unsupervised learning, principal component analysis, clustering and classification methods, regression, learning and generalization, deep neural networks).

Intended Learning Outcomes:
Upon successful completion of the module, participants are able to apply knowledge and methods in a research project in the field of Computer Engineering. They have deepened and further cross-linked their understanding of Computer Engineering and related topics acquired by the third-semester modules EI10007 (Principles of Information Engineering) and EI10008 (Machine Learning and Data Science).
Students are able to analyze elements of the solution space of the given research problem in a team under given technical, economic and social constraints. In doing so, they can work out important questions related to the research problems in Computer Engineering and clarify them in close coordination with experts from this area. They are able to apply the theoretical knowledge acquired in the third semester such as a basic understanding of Information Engineering and Machine Learning and practical capabilities such as information transmission and storage, communication networks, data processing devices, and develop their own solutions or solution contributions to the related research questions in a team. They are able to prepare the solution developed in the project in such a way that they can present it to application experts in a written form and orally. Students acquire missing knowledge and skills in Computer Engineering related to the research question of the project by private study under the guidance of the advisors.

Teaching and Learning Methods:
The module consists of project work.
Teaching format: individual consulting by the supervisor and advisor(s) (individual appointments between team and advisor).
Learning method: self-study and project work in a team under supervision of the advisors.
Self-study is an appropriate learning method regarding the intended learning goals, because the students train to efficiently acquire required knowledge and skills in Informatics to a degree that allows them (in collaboration with Computer Engineering experts) to understand basic aspects of a scientific problem in Computer Engineering, it’s basic solution space and related technology without having to master all details of this knowledge and skills. This is a core skill for future managers in technology-related fields.

Project work in a team is an appropriate learning method because students deepen their team-working skills in a technological field which is another core skill or future managers. Tentative team size is 2-4 students.

Media:
Will be announced by supervisor before the project starts.

Reading List:
General literature to project management:
Rowe, S. (2015). Project Management for Small Projects, 2nd Edition. Oakland: Berrett-Koehler Publishers.
Specific literature will be announced by the supervisor before the project starts.

Responsible for Module:
EI Dean of Study

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

INHN0003: Introduction to Computer Organization and Technology - Computer Architecture | Einführung in die Rechnerarchitektur

Version of module description: Gültig ab winterterm 2021/22

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 8	**Total Hours:** 240	**Self-study Hours:** 150	**Contact Hours:** 90

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination will be conducted in written form as part of a 120 minute exam. Here, examples from different areas of machine oriented programming in Assembler, micro-programming, circuit design and hardware description languages will be used to assess the capability of the students to master such concepts of computer architectures. Answers to short questions about basic concepts in computer architecture must show that the candidates mastered these concepts. Support material is provided during the examination, no additional help is allowed.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
None

Content:
- Computer systems: basic architecture and organization: Von- Neumann-Computer, machine-instruction cycle, hardware-software interface
- The Instruction Set Architecture (ISA): functionality and machineoriented Assembler programming
- Micro-programmed implementation of machine instructions
- Circuits, sequential circuits, circuit design with a formal language using the example of VHDL
- Introduction to computer architecture: microprocessor architectures and systems, parallel and distributed systems,
memory systems, I/O

Intended Learning Outcomes:
After attending this module students are able to understand computer systems as layered abstract machines. They get a first impression of the area of computer architectures and possess the following abilities:
They have learned to apply the main concepts of machine-oriented programming, microprogramming and circuit design. They understand the machine instruction cycles based on the underlying hardware at the register transfer level and they are able to classify computer architectures. The understand the basics of modern computer architecture.

Teaching and Learning Methods:
Using slide decks with animations, the lecture explains the basic concepts of computer architecture. This is supported by a concurrent series of central exercise sessions as well as small tutor groups, which explain the application of the material presented in the class. Homework allows the students to self-study the material. Solutions are then discussed both in the central exercise class as well as the smaller tutor groups. The ability to present their own solution as part of the tutor groups further aids in the understanding of the material and supports the students' ability to communicate.

Media:
Slides of lectures, exercise sheets with assignments, collections of assignments, other working material.

Reading List:
- Andrew S. Tanenbaum, Todd Austin: Rechnerarchitektur: Von der digitalen Logik zum Parallelrechner
- David A. Patterson, John L. Hennessy, Computer Organization and Design: The Hardware/ Software Interface
- Intel386 TM DX MICROPROCESSOR 32-BIT CHMOS MICROPROCESSOR WITH INTEGRATED MEMORY
MANAGEMENT
- Beschreibung der mikroprogrammierbaren Maschine

Responsible for Module:
Trinitis, Carsten; Prof. Dr.-Ing.

Courses (Type of course, Weekly hours per semester), Instructor:
Einführung in die Rechnerarchitektur (INHN0003) (Vorlesung, 4 SWS)
Trinitis C [L], Trinitis C

Übungen zu Einführung in die Rechnerarchitektur (INHN0003) (Übung, 2 SWS)
Trinitis C [L], Trinitis C
For further information in this module, please click campus.tum.de or here.

Module Description

IN8028: Project Work in Informatics | Project Work in Informatics

Version of module description: Gültig ab winterterm 2018/19

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 12	**Total Hours:** 360	**Self-study Hours:** 330	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module grade is based on a research paper (6-8 pages in IEEE double column conference format) and a presentation (20 minutes).
The research paper summarizes the results of the project work until the end of the semester.
By writing the research paper, students show their ability to work and write scientifically. In the research paper students demonstrate that they are able to apply knowledge and methods within a research project in the field of Informatics. They show that they can work out important questions related to the research problem.
At the end of the lecture period, participants give a 20-minute talk summarizing their results.
Students show their ability to present their results in a structured and comprehensible manner.
Moreover, they demonstrate that they are able to respond competently to questions related to their topic. Each team member should contribute to the presentation.
At the end of the semester students have to hand in a declaration, which summarizes the exact contributions for each team member (for the research paper, for the written code, for the conducted evaluation experiments, or for other products and activities of the research project).
Additionally, regular supervision meetings with the supervisor and advisors and the project report ensure that student contributions may be assessed on an individual basis. The team member's individual project contributions and submitted work is graded by the supervisor.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
• IN8005 Introduction to Informatics for Students of Management and & Technology
• IN8027 Introduction to Informatics for Students of Management & Technology – Programming Lab Course

Content:
The project work centers on a research question in the field of work of the supervisor and the advisor (typically a doctoral student). Students experience hands-on work in a project, where they work together in teams. They pass through the whole process of a small scientific project. The content depends on the research question and the elements of scientific project work. Example content: In a design science methodology driven research program, an intermediate technological artifact (e.g. a software system) has been developed as an intermediate result by the advisor under the guidance of the supervisor. As an example, consider a user interface for an interactive visual data-exploration system. The project work of the student team may consist in systematically evaluating this technological artifact with the help of human study participants in focus groups. The contents of the module then encompass quantitative and qualitative evaluation methods, the technology of the artifact, content elements of the theoretical background of the research question / research field (e.g. UI-Design, Information Visualization, Data-Mining).

Intended Learning Outcomes:
Upon successful completion of the module, participants are able to apply knowledge and methods in a research project in the field of Informatics.
They have deepened and further cross-linked their understanding of Informatics and the Informatics-related topics acquired by the third-semester modules IN8005, IN8027 (Introduction to Informatics for Students of Management & Technology – Programming Lab Course).
Students are able to analyze elements of the solution space of the given research problem in a team under given technical, economic and social constraints. In doing so, they can work out important questions related to the research problem in an Informatics field and clarify them in close coordination with experts from this area.
They are able to apply the theoretical knowledge acquired in the third semester such as a basic understanding of Machine Learning and practical capabilities such as programming in Java, using Machine Learning Libraries, or practical Software Engineering skills to an Informatics research-problem and develop their own solutions or solution contributions to the related research questions in a team.
They are able to prepare the solution developed in the project in such a way that they can present it to application experts in a written form and orally.
Students acquire missing Informatics knowledge and skills related to the research question of the project by private study under the guidance of the advisors.

Teaching and Learning Methods:
The module consists of project work.
Teaching format: individual consulting by the supervisor and advisor(s) (individual appointments between team and advisor).
Learning method: self-study and project work in a team under supervision of the advisors.
Self-study is an appropriate learning method regarding the intended learning goals, because the students train to efficiently acquire required knowledge and skills in Informatics to a degree that allows them (in collaboration with Informatics experts) to understand basic aspects of a scientific problem in Informatics, it’s basic solution space and related technology without having to master

all details of this knowledge and skills. This is a core skill for future managers in technology-related fields.
Project work in a team is an appropriate learning method because students deepen their interdisciplinary team-working skills in a technological field, which is another core skill or future managers. Team size is 2-4 students.

Media:
Will be announced by supervisor before the project starts.

Reading List:
General literature to project management:
Rowe, S. (2015). Project Management for Small Projects, 2nd Edition. Oakland: Berrett-Koehler Publishers.
Specific literature will be announced by the supervisor before the project starts.

Responsible for Module:
Groh, Georg; Apl. Prof. Dr. rer. nat. habil.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

MW2408: Project Work in Mechanical Engineering | Projektarbeit im Maschinenbau

Version of module description: Gültig ab summerterm 2020

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 12	**Total Hours:** 360	**Self-study Hours:**	**Contact Hours:**

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module grade is based on a research paper (6-8 pages in IEEE double column conference format) and a presentation (20 minutes, including a demonstration whenever relevant).
The research paper summarizes the results of the project work until the end of the semester.
By writing the research paper, students show their ability to work and write scientifically. In the research paper students demonstrate that they are able to apply knowledge and methods within a research project in the field of Mechanical, Production and System Engineering. They show that they can work out important questions related to the research problem.
At the end of the lecture period, participants give a 20-minute talk summarizing their results. Students show their ability to present their results in a structured and comprehensible manner. Moreover, they demonstrate that they are able to respond competently to questions related to their topic. Each team member should contribute to the presentation.
At the end of the semester students have to hand in a declaration, which summarizes the exact contributions for each team member (for the research paper, for the written code, for the conducted evaluation experiments, or for other products and activities of the research project).
Additionally, regular supervision meetings with the supervisor and advisors and the project report ensure that student contributions may be assessed on an individual basis. The team member’s individual project contributions and submitted work is graded by the supervisor.

Note in view of the limitations on university operations as a result of the CoViD19 pandemic: If the basic conditions (hygiene, physical distance rules, etc.) for a classroom-based examination cannot be met, the planned form of examination can be changed to a written or oral online examination in accordance with §13a APSO. The decision about this change will be announced as soon as possible, but at least 14 days before the date of the examination by the examiner after consultation with the board of examiners of the respective study program.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
MW2383: Modeling and Analysis of Digital Control Systems
MW1921: Logistics Engineering in Production Systems and Supply Chain Management

Content:
The project work is centered around a research question in the field of work of the supervisor and the advisor (typically a doctoral student). Students experience hands-on work in a project, where they work together in teams. They pass through the whole process of a small scientific project. The content depends on the research question and the elements of scientific project work.
Example contents:
Example 1: The project work of the student team may consist in systematically evaluating different suggested solutions proposed by experts to solve a specific technical problems in the field of Industry 4.0 or Industrial Internet of Things. This type of project would focus on the skills required to understand and evaluate existing technical solutions.
Example 2: The project work of the student team may consist in developing new technical solutions (either as a product or as a service) by combining existing technologies and solutions that are usually not combined. This type of project would focus on the skills required to express and communicate a sketch of a solution to experts from different technical fields.
Example 3: The project work of the student team may consist in improving or optimizing one existing solution proposed by an expert in the field of logistics, production engineering or cyber-physical systems. This type of project would focus on strengthening technical skills on one specific domain, or on one dedicated software tool.

Intended Learning Outcomes:
Upon successful completion of the module, participants are able to apply knowledge and methods in a research project in the field of Mechanical, Production and System Engineering. They have deepened and further cross-linked their understanding of Mechanical Engineering and related topics acquired by the third-semester modules MW2383 (Modeling and Analysis of Digital Control Systems) and MW1921 (Logistics Engineering in Production Systems and Supply Chain Management).
Students are able to analyze elements of the solution space of the given research problem in a team under given technical, economic and social constraints. In doing so, they can work out important questions related to the research problems in Mechanical, Production and System Engineering and clarify them in close coordination with experts from this area. They are able to apply the theoretical knowledge acquired in the third semester such as a basic understanding of the modeling concepts and methods used in the domain of digital control systems, and logistics and production systems, as well as practical capabilities such as using relevant tools for the analysis, optimization and implementation of such systems. The students are also able to develop their own solutions or solution contributions to the related research questions in a team. They are able to prepare the solution developed in the project in such a way that they can present it to application experts in a written form and orally. Students acquire missing knowledge and skills in

Mechanical, Production and System Engineering related to the research question of the project by private study under the guidance of the advisors.

Teaching and Learning Methods:
The module consists of project work.
Teaching format: individual consulting by the supervisor and advisor(s) (individual appointments between team and advisor).
Learning method: self-study and project work in a team under supervision of the advisors.
Self-study is an appropriate learning method regarding the intended learning goals, because the students train to efficiently acquire required knowledge and skills in Informatics to a degree that allows them (in collaboration with Mechanical Engineering experts) to understand basic aspects of a scientific problem in Mechanical, Production and System Engineering, its basic solution space and related technology without having to master all details of this knowledge and skills. This is a core skill for future managers in technology-related fields.
Project work in a team is an appropriate learning method because students deepen their team-working skills in a technological field which is another core skill or future managers. Tentative team size is 2-4 students.

Media:
Will be announced by supervisor before the project starts.

Reading List:
General literature to project management:
Rowe, S. (2015). Project Management for Small Projects, 2nd Edition. Oakland: Berrett-Koehler Publishers.
Specific literature will be announced by the supervisor before the project starts.

Responsible for Module:
Provost, Julien; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Project Studies | Project Studies

Module Description

WIHN0684: Project Studies | Projektstudium

Version of module description: Gültig ab winterterm 2019/20

Module Level: Bachelor	**Language:** German/English	**Duration:**	**Frequency:** winter/summer semester
Credits:* 12	**Total Hours:** 360	**Self-study Hours:** 360	**Contact Hours:**

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The project study is a practical project, where a studentical team of 2-5 students work on a specific task of a company or any other similar institution (including research projects at university chairs). Here the students frame the state of research and describe their own specific solution. Based on scientific knowledge and methodical skills, the students evolve the task. The project study is supported by a professor of the TUM School of Management and a company. The students frame the state of research and develop their own specific approach for a solution based on scientific knowledge as well as methodical skills. Depending on the project, the student team presents the results of the project study through a written term paper. Grading will especially take into account the overall working outcome of the project with respect to the initial problem set, the selection and application of the chosen methodology as well as the discussion of the main findings. The project is set up in a way which enables identification and evaluation of each student’s individual contribution to the project’s success.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowlege in Business Administration

Content:
In the project study, students acquire hands-on experience by working in student teams with companies/institutions on a particular assignment.
Examples are
- the application of optimization tools for problems out of the logistic sector,
- the application of specific use cases for new electronic payment procedures,

- the capturing and processing of KPIs in controlling,
- or the description of a marketing strategy.
They structure the project and employ their methods and theories to develop results of practical value for the company/institution. The project is supervised jointly by mentors from the respective partner company and the professor of the TUM School of Management. With regards to content the project study takes an approximate time of three to six month.

Intended Learning Outcomes:
After successful participation in the module students are able work on a project in a systematic and academic manner. They can contribute an own part to a team's work output. They can make this contribution in a time limited environment. The students can identify and express problem sets. Furthermore they can name appropriate methodologies for problem solving and they can transfer them to the solution. Finally they can choose and apply the appropriate methodologies to solve the problem.

Teaching and Learning Methods:
The creation of the project solution in a team encourages the students to deal soundly with a practical subject. They are able to communicate the evolvment of the project within the team and to present the solution to the supervisors from the company/institution and the university.

Media:
literature, presentations

Reading List:
General literature to project management:
Rowe, S. (2015). Project Management for Small Projects, 2nd Edition. Oakland: Berrett-Koehler Publishers.
Relevant literature will be selected and communicated specifically for the project.

Responsible for Module:
Stich, Michael; Prof. Dr. rer. oec.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Electives in Management and/or Technology | Electives in Management and/or Technology

For the Elective in Management & Technology, students must pass examinations in the area of management or technology worth 18 credits. The following is a sample catalog of electives.

Digital Technologies | Digital Technologies

Module Description

INHN0003: Introduction to Computer Organization and Technology - Computer Architecture | Einführung in die Rechnerarchitektur

Version of module description: Gültig ab winterterm 2021/22

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 8	**Total Hours:** 240	**Self-study Hours:** 150	**Contact Hours:** 90

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination will be conducted in written form as part of a 120 minute exam. Here, examples from different areas of machine oriented programming in Assembler, micro-programming, circuit design and hardware description languages will be used to assess the capability of the students to master such concepts of computer architectures. Answers to short questions about basic concepts in computer architecture must show that the candidates mastered these concepts. Support material is provided during the examination, no additional help is allowed.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
None

Content:
- Computer systems: basic architecture and organization: Von- Neumann-Computer, machine-instruction cycle, hardware-software interface
- The Instruction Set Architecture (ISA): functionality and machineoriented Assembler programming
- Micro-programmed implementation of machine instructions
- Circuits, sequential circuits, circuit design with a formal language using the example of VHDL
- Introduction to computer architecture: microprocessor architectures and systems, parallel and distributed systems,
memory systems, I/O

Intended Learning Outcomes:
After attending this module students are able to understand computer systems as layered abstract machines. They get a first impression of the area of computer architectures and possess the following abilities:
They have learned to apply the main concepts of machine-oriented programming, microprogramming and circuit design. They understand the machine instruction cycles based on the underlying hardware at the register transfer level and they are able to classify computer architectures. The understand the basics of modern computer architecture.

Teaching and Learning Methods:
Using slide decks with animations, the lecture explains the basic concepts of computer architecture. This is supported by a concurrent series of central exercise sessions as well as small tutor groups, which explain the application of the material presented in the class. Homework allows the students to self-study the material. Solutions are then discussed both in the central exercise class as well as the smaller tutor groups. The ability to present their own solution as part of the tutor groups further aids in the understanding of the material and supports the students' ability to communicate.

Media:
Slides of lectures, exercise sheets with assignments, collections of assignments, other working material.

Reading List:
- Andrew S. Tanenbaum, Todd Austin: Rechnerarchitektur: Von der digitalen Logik zum Parallelrechner
- David A. Patterson, John L. Hennessy, Computer Organization and Design: The Hardware/ Software Interface
- Intel386 TM DX MICROPROCESSOR 32-BIT CHMOS MICROPROCESSOR WITH INTEGRATED MEMORY
MANAGEMENT
- Beschreibung der mikroprogrammierbaren Maschine

Responsible for Module:
Trinitis, Carsten; Prof. Dr.-Ing.

Courses (Type of course, Weekly hours per semester), Instructor:
Einführung in die Rechnerarchitektur (INHN0003) (Vorlesung, 4 SWS)
Trinitis C [L], Trinitis C

Übungen zu Einführung in die Rechnerarchitektur (INHN0003) (Übung, 2 SWS)
Trinitis C [L], Trinitis C
For further information in this module, please click campus.tum.de or here.

Economics & Policy | Economics & Policy

Module Description

MGTHN0059: Negotiation Seminar | Negotiation Seminar

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** irregularly
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 146	**Contact Hours:** 34

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination consists of a presentation of contents and results of the seminar paper in an oral report, including subsequent discussion (25% of the grade) of the results. Moreover, students will prepare a seminar paper. In order to support students in writing their seminar papers, there will be regular discussions about the progression of the project and next steps (seminar paper and regular discussions = 50% of the grade). On top of that, students participation in the negotiation simulations and the subsequent discussions will be evaluated (25% of the grade). The seminar paper and the corresponding presentation are a means to measure the student's ability to understand a scientific subject, to evaluate literature as well as to develop, conduct and analyze questionnaires/surveys. By doing a presentation, students show that they can summarize the subject, present it to an audience, and to conduct a discussion about the presented subject. Regular discussions with the instructor measure the student's ability to develop an idea from initial concepts to the complete picture within a given timeframe. The participation in the negotiation simulations measure the students ability to apply their theoretical knowledge in practice and to reflect on it afterwards.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
None

Content:
Basic terms of contract negotiations (like BATNA and ZOPA etc.);
Negotiation strategies and concepts (Harvard negotiation concept, win-win, win-lose etc.);
Effects of behavioural economics and negotiation tactics based on it (anchoring effect etc.);

Negotiation tactics (based on deception, pressure and defensive tactics etc.);
Communication (question techniques, answer techniques, argumentation techniques); framework conditions in negotiations (e.g. principal-agent-problems, emotions etc.)

Intended Learning Outcomes:
Students learn the economic and psychological basics of contract negotiations as well as important communication tools for negotiations. They know the Harvard negotiation concept and the most important strategies in contract negotiations. They are familiar with essential negotiation tactics. Students know how to apply these tactics or respectively how to react to these tactics if applied by the negotiation partner. They can distinguish different negotiation styles. Students have experienced the functioning of individual tactics during negotiation simulations and are able to understand the dynamics underlying a specific negotiation.
In the area of interdisciplinary competences, students strengthen their communication and argumentative skills (especially through the negotiation simulations) and their ability to work in a team (especially through group work in the context of presentations and negotiation simulations in a team).

Teaching and Learning Methods:
This module is held as an interactive seminar/lecture. Negotiation simulations and games are integrated into the course so that students learn to implement tactics and strategies. The negotiation games are designed to simulate practice. Students are encouraged to actively participate in the negotiation simulations and to get involved in the subsequent discussions. Video recordings are used to reflect on what has been experienced. Moreover, students will do research on a specific research question and write a seminar paper. In this framework, students will have to perform research of reference materials, design a questionnaire, conduct interviews with negotiators and analyse the answers. In order to support the students in their work individual appointments will be offered. Students will present their work in class.

Media:
Simulations, Exercises, Videos, Self-Tests, PPT, Whiteboard

Reading List:
Jung/Krebs, The Essentials of Contract Negotiation (2019)

Responsible for Module:
Jung, Stephanie; Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Negotiation Seminar (BMT Heilbronn) (Seminar, 4 SWS)
Gelvez Alvarez L, Jung S
For further information in this module, please click campus.tum.de or here.

Innovation & Entrepreneurship | Innovation & Entrepreneurship

Module Description

MGTHN0056: Seminar in Innovation and Entrepreneurship: Innovation Management in Family Enterprises | Seminar in Innovation and Entrepreneurship: Innovation Management in Family Enterprises

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Each seminar participant will work individually on a specific topic related to innovation management in family enterprises (e. g., the comparison of commitment to innovation management of family vs. non-family enterprises or importance of innovation for family enterprise success). The examination consists of two parts:
1) Seminar thesis (80 % of the overall grade). The students should demonstrate that:
- they have gained a deeper knowledge of the topics dealt within the course.
- they show that they are able to write a paper that follows a clear logic and is based on sound literature.
- they are able to identify promising research quesions and know how to structure and write a seminar thesis.
2) Presentation of the seminar thesis (20 % of the overall grade). Students should demonstrate that:
- they have gained the skills to present their seminar thesis to an academic audience.
- they are able to answer questions related to specific parts of their work.
The final grade will be based on the two parts (80 % seminar thesis and 20 % presentation and discussion of the seminar thesis).

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Fluency in spoken and written English

Content:
Family enterprises are owned and/or managed by families which face unique challenges to achieve growth and long-term sustainability. In doing so, innovation represents a critical antecedent to firm survival. Family entrprises often have long traditions and introducing innovation is often associated with tensions. This course addresses various aspects of such innovation management processes in family enterprises- Particular attention is paid to how family enterprises innovate, types of innovation that family firms integrate as well as which benefits innovation brings to them. An examination on digitalization of family firms as a way to implement innovation is also included in this course.

Subject-specific content:
- Basic concepts in the fields of innovation management as well as family enterprises
- Innovation from a family firm perspective, including the management of innovation processes
- Types and determinants of innovation management in family enterprises
- Digital transformation in family enterprises

Methodological content (limited to an introductory level)
- Conducting scientific research
- Presenting academic pieces of work

Intended Learning Outcomes:
After completing the seminar, students are able to:
- understand the basic concepts in the fields of innovation management as well as family enterprises,
- analyze the challenges and opportunities that family enterprises face in order to promote corporate innovation,
- analyze different types of innovations and the innovation processes in family enterprises
- evaluate the meaning as well as challenges and opportunities of digital transformation in family enterprises, and
- apply the learned concepts in giving management recommendations in the context of innovation managment in family firms

In addition, students will be able to:
- understand selected research papers and evaluate their key findings,
- present and explain research studies in a comprehensible and interesting manner in front of an academic audience;
- correctly search for academic literature, apply rigorous methods for data collection and data analysis as well as know-how to structure and write a seminar thesis.

Teaching and Learning Methods:
- Through lectures, supported by Power-Point presentations, the instructors will provide the theoretical foundations of innovation management in family enterprises.
- The content is discussed in the course by openly exchanging ideas. Questions, and comments will encourage a vivid and learning atmosphere and constructive discussions.

- Every sessions contains exercises, in which the students apply their learnings in practical context (e.g. case studies with family enterprises struggling to promote innovation by Harvard Business Review).
- Guest speakers will share practical insights and will strengthen the understanding of key concepts and will therefore complement the perspectives of the seminar.
- In their seminar papers, students should investigate a selected topic within the field. For instance, they could conduct a literature review or develop or explain the innovation management approach of a specific family firm which they identify themselves.

Media:
Powerpoint, Zoom- & Breakout-Sessions, Kahoot-Sessions, Online Simulations

Reading List:

Bessant, J., & Tidd, J. (2007). Innovation and Entrepreneurship (John Wiley & Sons). Chichester, UK.
Knight, K. E. (1967). A descriptive model of the intra-firm innovation process. The Journal of Business, 40(4), 478–496.
Ritala, P., Schneider, S., & Michailova, S. (2020). Innovation management research methods: Embracing rigor and diversity. R&D Management, 50(3), 297–308. https://doi.org/10.1111/radm.12414
Berent-Braun, M. M., & Uhlaner, L. M. (2012). Family governance practices and teambuilding: Paradox of the enterprising family. Small Business Economics, 38(1), 103–119. https://doi.org/10.1007/s11187-010-9269-4
Davis, P. (1983). Realizing the potential of the family business. Organizational Dynamics, 12(1), 47–56. https://doi.org/10.1016/0090-2616(83)90026-8
Gomez-Mejia, L., Basco, R., Gonzalez, A. C., & Muller, C. G. (2020). Family business and local development in Iberoamerica. Cross Cultural & Strategic Management, 27(1), 51–66. https://doi.org/10.1108/CCSM-02-2020-223
Le Breton-Miller, I., & Miller, D. (2018). Beyond the firm: Business families as entrepreneurs. Entrepreneurship Theory and Practice, 42(4), 527–536. https://doi.org/10.1177/1042258717739004
Chrisman, J. J., Chua, J. H., Massis, A. D., Frattini, F., & Wright, M. (2015). The ability and willingness paradox in family firm innovation. Journal of Product Innovation Management, 32(3), 310–318. https://doi.org/10.1111/jpim.12207
Erdogan, I., Rondi, E., & De Massis, A. (2020). Managing the tradition and innovation paradox in family firms: a family imprinting perspective. Entrepreneurship Theory and Practice, 44(1), 20–54. https://doi.org/10.1177/1042258719839712
Miller, D., Wright, M., Breton-Miller, I. L., & Scholes, L. (2015). Resources and innovation in family businesses: The Janus-face of socioemotional preferences. California Management Review, 58(1), 20–40. https://doi.org/10.1525/cmr.2015.58.1.20
Cassia, L., De Massis, A., & Pizzurno, E. (2012). Strategic innovation and new product development in family firms: An empirically grounded theoretical framework.

International Journal of Entrepreneurial Behavior & Research, 18(2), 198–232. https://doi.org/10.1108/13552551211204229
Massis, A. D., Frattini, F., Pizzurno, E., & Cassia, L. (2015). Product innovation in family versus nonfamily firms: An exploratory analysis. Journal of Small Business Management, 53(1), 1–36. https://doi.org/10.1111/jsbm.12068
De Massis, A., Frattini, F., & Lichtenthaler, U. (2013). Research on technological innovation in family firms: Present debates and future directions. Family Business Review, 26(1), 10–31. https://doi.org/10.1177/0894486512466258
Pittino, D., Visintin, F., Minichilli, A., & Compagno, C. (2021). Family involvement in governance and firm performance in industrial districts. The moderating role of the industry's technological paradigm. Entrepreneurship & Regional Development, 0(0), 1–18. https://doi.org/10.1080/08985626.2021.1925848

Responsible for Module:
Bird, Miriam; Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Seminar in Innovation and Entrepreneurship: Innovation Management in Family Enterprises (BMT Heilbronn) (Seminar, 4 SWS)
Bird M, Martinez Sanchis P
For further information in this module, please click campus.tum.de or here.

Marketing, Strategy & Leadership | Marketing, Strategy & Leadership

Module Description

MGTHN0060: Leadership in Family Enterprise | Leadership in Family Enterprise

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 150	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Grading is based on a seminar paper (20 pages) and
a presentation (20 minutes). The students work on a specific problem set within an exemplary organization. The students show that they are able to compose the state of research, and that they are able to present and discuss their findings. In addition they demonstrate their ability to develop their own specific approach for a solution based on empirical evidence.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
The seminar deals with relevant topics in the field of leadership that arise in family enterprises The focus here is on the empirical evidence in the respective research field. Through critical evaluation of the existing research literature, the students are able to gain scientifically sound knowledge and to work out solutions for specific research questions.

Intended Learning Outcomes:
Students are encouraged to deal with an practical problem based on their newly acquired academic knowledge. Students will communicate the solution to this problem by composing a seminar thesis and preparing a presentation of their solution to the supervisor and fellow students. Discussion with their fellow students will enable them to improve the final version of the seminar thesis. Supervision takes place through a kick-off meeting as well as interim meetings.

Teaching and Learning Methods:
Students are encouraged to deal with an practical problem based on their newly acquired academic knowledge. Students will communicate the solution to this problem by composing a seminar thesis and preparing a presentation of their solution to the supervisor and fellow students. Discussion with their fellow students will enable them to improve the final version of the seminar thesis. Supervision takes place through a kick-off meeting as well as interim meetings.

Media:
Literature, presentations

Reading List:

Responsible for Module:
Dlouhy, Katja; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Leadership in Family Enterprise (MGTHN0060) (Seminar, 2 SWS)
Dlouhy K
For further information in this module, please click campus.tum.de or here.

Operations & Supply Chain Management | Operations & Supply Chain Management

Module Description

MGTHN0051: Predictive Analytics and Forecasting | Predictive Analytics and Forecasting

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** irregularly
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 135	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In order to check whether students can calculate forecasts using the R software, they receive data that needs to be analysed. They have to select a suitable method and determine the forecasts. Thus, the first part of the exam is a practice performance (programming task, 50%). In the second part of the exam, students must present the results of a small project that focuses on forecasting in a presentation (20 minutes, 50%) and be able to defend their approach in the subsequent discussion.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
- Basics in statistics
- Basics in probability calculus

Content:
The following topics are discussed
1) Basic forecasting tools
2) Exponential Smoothing 3) Forecasting Spare Parts Demand
4) Regression models
5) ARIMA models
6) Hierarchical Forecasting
7) Neural Networks

Intended Learning Outcomes:
The students
- understand the importance of data analysis for business forecasting
- know different forecasting techniques
- are able to select the right forecasting method and apply it
- can use the software R to compute forecasts
- are able to present forecasts and explain their derivation

Teaching and Learning Methods:
Group work, Programming with R, Presentations, Exercises

Media:
PowerPoint Slides, Daten, Video conferences, Exercises

Reading List:
- Hyndman, R.J., Athanasopoulos, G. (2012) Forecasting: principles and practice. Otexts
- Ord, K., Fildes, R. (2013) Principles of Business Forecasting. Cengage Learning.

Responsible for Module:
Kiesmüller, Gudrun; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Predictive Analytics and Forecasting (MGTHN0051) (BMT Heilbronn) (Vorlesung mit integrierten Übungen, 4 SWS)
Kiesmüller G, Sachs F
For further information in this module, please click campus.tum.de or here.

Module Description

MGTHN0054: Seminar Operations & Supply Chain Management: Supply Chain Finance | Seminar Operations & Supply Chain Management: Supply Chain Finance [SCF & SCRM]

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Upon completion of this module, students will demonstrate their ability to cope with advanced research studies, to comprehend and assess study outcomes, to compare contributions of several studies, and to transfer theoretical concepts to practice through a seminar paper (70% of final grade; length of 15 pages including references). This method requires students to formulate an academic paper themselves; it can be seen as an exercise towards writing a master thesis.

In addition, they will prove their ability to communicate even complicated relationships and methods to their peer students through a presentation in a comprehendable fashion. They will further guide and moderate an ensuing discussion throughout which they will demonstrate their ability to criticize and assess innovative approaches and their potential shortcomings. The presentation including moderation of ensuing discussion accounts for 30% of the final grade (presentation duration 25 minutes + 25 minutes discussion). Complementing the written seminar paper, the presentation is targetted towards students who have not read the set of same papers; this poses the challenge to present theoretic work in an interesting fashion while breaking down complex relationships into understable information without loosing rigor.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Management Science, Production and Logistics

Content:
Subject-specific content
• Supply Chain Finance

• Reverse Factoring
• Supply Chain Risk Management
• Finance and Operations Interface

Methodological content (depending on assigned papers and limited to an introductury level)
• Research Design
• Analytical Modelling
• Game Theory
• Event Study Method
• Econometrics

Intended Learning Outcomes:
Upon completion of the module, students are able to
• understand and analyze state-of-the-art approaches to supply chain finance and supply chain risk management,
• summarize selected research papers and evaluate their key findings,
• present and explain advanced research studies in a comprehensible and interesting manner,
• evaluate suggested management solutions in the supply chain finance and supply chain risk management context and assess their strengths and weaknesses,
• create management recommendations based on recent academic studies,
• and criticize innovative approaches by assessing potential shortcomings.

Teaching and Learning Methods:
Seminar
Each students will be provided with three research papers and asked to study them intensively. Each student in this seminar receives a different set of papers. As one form of guidance, students will be provided with a detailed set of questions that they need to answer. Students are asked to prepare a seminar paper, that is, an academic essay in which they critically reflect upon the questions they are provided with. This seminar paper will be written in a scientific style. At a later stage in the semester, all students present their findings and moderate an ensuing discussion. Throughout the semester, Moodle will be leveraged to provide ongoing feedback and incentives to start working early on on the assigned questions. At the beginning of the semester, specific milestones with deadlines will also be provided.

Media:
Research papers (to be shared via Moodle), student presentations, further material to be shared via Moodle, online discussions

Reading List:
Readings for general preparation (i.e., what is research? What marks a contribution?):

Wacker, J. G. (1998). A definition of theory: research guidelines for different theory-building research methods in operations management. Journal of operations management, 16(4), 361-385.

Whetten, D. A. (1989). What constitutes a theoretical contribution? Academy of management review, 14(4), 490-495.

Examples for typical papers that we will discuss (this list is not meant to be comprehensive, but gives some indication of topics to be covered):

Hendricks, K. B., & Singhal, V. R. (2003). The effect of supply chain glitches on shareholder wealth. Journal of operations Management, 21(5), 501-522.

Peura, H., Yang, S. A., & Lai, G. (2017). Trade credit in competition: a horizontal benefit. Manufacturing & Service Operations Management, 19(2), 263-289.

Wuttke, D. A., Rosenzweig, E. D., & Heese, H. S. (2019). An empirical analysis of supply chain finance adoption. Journal of Operations Management, 65(3), 242-261.

Yang, S. A., Birge, J. R., & Parker, R. P. (2015). The supply chain effects of bankruptcy. Management Science, 61(10), 2320-2338.

Further papers will be provided at the beginning of the semester

Responsible for Module:
Wuttke, David; Prof. Dr. rer. pol.

Courses (Type of course, Weekly hours per semester), Instructor:
Seminar Operations & Supply Chain Management: Supply Chain Finance (MGTHN0054) (BMT Heilbronn) (Seminar, 4 SWS)
Marlenova B, Wuttke D
For further information in this module, please click campus.tum.de or here.

Module Description

MGTHN0057: Seminar Operations & Supply Chain Management: Business Analytics and its Application | Seminar Operations & Supply Chain Management: Business Analytics and its Application

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 135	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination consists of two parts: 1. The presentation (25% of the overall grade) by which it is proved that the students: have a solid overview over business and data analytics, and have modelling and data analytics skills in solving practical problems. 2. The research report (75% of the overall grade) by which it is proved that the students: understand the literature on a subtopic in the field of business analytics with applications, have learned the most important research methods in business analytics, are able to detect promising research questions and finding innovative ways to investigate them using data. The overall grade is calculated by averageing written work (75%) and presentation (25%).

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Foundations in statistics and management science

Content:
In this seminar, we will discuss how to use big data to solve business problems, and have a good understanding of business analytics. The seminar generally has four parts. Part 1: Review the literture on business analytics, review the literature on data analytics. Part 2: Examine and identify various public databases, for example, open source data (google mobility data), data from organizations such as WHO. Part 3: Propose a research question, build the correct model and find the approporiate dataset to support the analysis. Part 4. Present research ideas and write an academic report. Thus, this course will be especially valuable to inspire research ideas and prepare for scientific work on the subsequent bachelor thesis or master study.

Intended Learning Outcomes:
Students who have participated in this seminar: have a comprehensive understanding of the scientific process; know about the most important issues of current business and management research; have a solid overview over diverse and innovative ways of collecting data and analyzing data; be able to think critically; solve business problems efficiently and innovatively using big data.

Teaching and Learning Methods:
Presentation, interactive teaching, e-learning, group discussions

Media:
Zoom, literature databases (Ebsco, ScienceDirect etc.), Databases, software development platform (e.g. GitHub)

Reading List:
Top 24 leading business journals - see https://jindal.utdallas.edu/the-utd-top-100-business-school-research-rankings/. In particular, we focus on the following five journals: Management Science, Operations Research, Journal of Operations Management, Manufacturing and Service Operations Management, Production and Operations Management. For example: Liu, J., Xie, J., Yang, K.K. and Zheng, Z., 2019. Effects of rescheduling on patient no-show behavior in outpatient clinics. Manufacturing & Service Operations Management, 21(4), pp.780-797. Xie, J., Zhuang, W., Ang, M., Chou, M.C., Luo, L. and Yao, D.D., Analytics for Hospital Resource Planning—Two Case Studies. Production and Operations Management.

Responsible for Module:
Xie, Jingui; Ph.D.

Courses (Type of course, Weekly hours per semester), Instructor:
Seminar Operations & Supply Chain Management: Business Analytics and its Application (BMT Heilbronn) (MGTHN0057) (Seminar, 4 SWS)
Xie J
For further information in this module, please click campus.tum.de or here.

Module Description

MGTHN0058: Introduction to Reinforcement Learning | Introduction to Reinforcement Learning

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module is evaluated by laboratory assignments. Students are paired into groups of two and work on homeworks and a project throughout the semester. Each group should submit the homeworks (30%), a written report (weighs 50%) and present in the last session of the couse (weighs 20%).
In the report, the students show the understanding of the theories and methods in the fields of reinforcement learning, and their ability to apply them to model real world problems, and to implement the solution with a programming language (Python). The presentation takes 20 minutes with 20 minutes discussion.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
The module requires a solid knowledge in advanced mathematics. It is better to know machine learning and deep learning. The experience of programming is helpful, because the students will use Python to finish the project.

Content:
The module covers different state of the art methods for reinforcement learning. Specifically the topics cover:
- Review of supervised/unsupervised learning
- Definition of reinforcement learning
- Markov decision process
- Dynamic programming
- Monte Carlo methods
- Temporal difference learning

- Q-learning
- SARSA
- Policy gradient
- Applications of RL

Intended Learning Outcomes:
After successful completion of this module, the students will (1) have a deep understanding of the concepts of reinforcement learning, (2) can explain the classical algorithms, such as Q-learning, SARAS, policy gradient and so on, based on the theoretical backgrounds, the students are able to (3) model the real world problem by reinforcement learning, and (4) implement the solution approaches by Python.

Teaching and Learning Methods:
The module consists of a series of lectures that introduce the theory and illustrate the examples and applications in practical. A series of exercise is after each lecture, so that the students can learn the programming and implementation skills.
The project for the students is aim to practice the classical algorithms learned in classes. In the written report, the students should learn to model a real world problem and implement by programming. .

Media:
Presentation slides, technical papers

Reading List:
Bach F., Sutton R., Barton A. Reinforcement learning: An introduction, The MIT Press (2018)

Responsible for Module:
Xie, Jingui; Ph.D.

Courses (Type of course, Weekly hours per semester), Instructor:
Introduction to Reinforcement Learning (BMT Heilbronn) - Lecture (Vorlesung, 2 SWS)
Xie J

Introduction to Reinforcement Learning (BMT Heilbronn) - Exercise (Übung, 2 SWS)
Xie J
For further information in this module, please click campus.tum.de or here.

Module Description

WIHN0038: Business Analytics | Business Analytics

Version of module description: Gültig ab winterterm 2020/21

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module is evaluated by assignments and projects. Each student should finish the assignments during the semester (40%) and work on a final project, which includes a written report (weighs 40%) and present in the last session of the course (weighs 20%).
In the report, the students show the understanding of the theories and methods in the fields of business analytics, and their ability to apply them to analyze real world data, and to implement the solution with a programming language (Python or R). The presentation takes 20 minutes with 20 minutes discussion.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Prerequisites: Statistics, Machine Learning, Econometrics, Management Science

Content:
The module covers different state of the art methods for business analytics. Specifically the topics cover:
1. Descriptive Analytics
Review of statistics
Introduction to R
Introduction to Python
2. Predictive Analytics
Review of machine learning (deep learning)
Review of econometrics
Regression models
Time series models
Simulation

3. Prescriptive Analytics
Review of Linear programming (Management Science)
Review of Dynamic programming (Reinforcement Learning)
Nonlinear optimization
Convex optimization
Robust optimization

Intended Learning Outcomes:
After successful completion of this module, the students will (1) understand of the key concepts and the most important issues of business analytics, (2) have a overview over diverse and innovative ways of collecting and analyzing data. Furthermore, by the software exercise, the students (3) learn to implement the data analysis approaches.

Teaching and Learning Methods:
The module consists of a series of lectures and software exercise. The lecture introduce the theory and illustrate the examples and applications in practical.
The software seminar offers instructions of Python and R, by which the business analytics methods could be implemented.
The final project for the students is aim to practice the classical algorithms learned in classes.
In the written report, the students should learn to model a real world problem and implement by programming. .

Media:
Presentation slides, software exercise, technical papers

Reading List:
Business Analytics: Data Analysis & Decision Making, 7th Edition, S.Christian Albright, Wayne L. Winston
Business Analytics, 4th Edition, Jeffrey D. Camm, James J. Cochran, Michael J Fry, Jeffrey W. Ohlmann
An Introduction to Statistical Learning with Applications in R, Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani.

Responsible for Module:
Xie, Jingui; Ph.D.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WIHN0042: Seminar Operations & Supply Chain Management Reinforcement Learning | Seminar Operations & Supply Chain Management Reinforcement Learning

Version of module description: Gültig ab winterterm 2020/21

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 135	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module is evaluated by two parts. The students should finish a written report (weighs 75%) and present in the last session of the course (weighs 25%).
In the report, the students show the understanding of the theories, methods and literature in the fields of reinforcement learning, and the application in the healthcare management area, and their ability to model real world problems in a innovative way, and find proper algorithm to find the optimal solution. It is encouraged to implement the solution with a programming language (Python). The presentation takes 20 minutes with 20 minutes discussion.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
The module requires a solid knowledge in advanced mathematics. It is better to know machine learning. The experience of programming is helpful.

Content:
In this seminar, we will discuss how to apply reinforcement learning to solve business problems. In particular, we will focous in the area of healthcare management. The seminar generally has three parts. Part 1: Review the literture on reinforcement learning, review the literature on healthcare decision making. Part 2: Propose a research question, build the correct model and find the approporiate algorithm. Part 3. Present research ideas and write an academic report. Thus, this course will be especially valuable to inspire research ideas and prepare for scientific work on the subsequent bachelor thesis or master study.

Intended Learning Outcomes:
After successful completion of this module, the students will (1) have a comprehensive understanding of the scientific process; (2) get deep understanding of the concepts and algorithms of reinforcement learning, (3) have a solid overview over diverse and innovatives of the application of reinforcement learning , based on the theoretical backgrounds, the students are able to (4) think critically, and (5) solve problems efficiently and innovatively using reinforcement learning.

Teaching and Learning Methods:
Presentation, interactive teaching, e-learning, group discussions

Media:
Zoom, technical papers

Reading List:
Top 24 leading business journals - see https://jindal.utdallas.edu/the-utd-top-100-business-school-research-rankings/. In particular, we focus on the following five journals: Management Science, Operations Research, Journal of Operations Management, Manufacturing and Service Operations Management, Production and Operations Management.

Responsible for Module:
Xie, Jingui; Ph.D.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Other Electives in Management and/or Technology | Other Electives in Management and/or Technology

Module Description

MGTHN0061: Corporate Campus Challenge | Corporate Campus Challenge

Version of module description: Gültig ab summerterm 2021

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 150	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Participants describe the business case, actual development, and the ultimate features of the created business solution/prototype in a final report (50% of the final grade) and a 20 minutes-presentation (50% of the final grade).

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Prior attendance of the following modules is recommended: Cost Accounting; Foundations of Entrepreneurial & Ethical Business; Investment & Financial Management.

Content:
The course captures a wide spectrum of practical challenges in the field of accounting, entrepreneurship, and financial management when developing a solution/prototype (e.g., modeling of business ideas and ecosystems, evaluation of customer needs, design thinking methodology, planning and reporting about milestones, rapid prototyping, and value forecasting).

Intended Learning Outcomes:
After successfully passing the module, the participants can
• apply different techniques of idea generation/identification and demands evaluation to stimulate creativity and recognize business opportunities,
• create design prototypes in order to demonstrate their proposed solutions and gather feedback,

• practically develop business plans, presentations, and video prototypes in order to communicate the novelty of the solution to stakeholders, and
• self-critically evaluate their ideas by involving peers, academics, and industry partners.

Teaching and Learning Methods:
Participants work in interdisciplinary teams to develop innovative solutions for current challenges in management, applied technologies, and societal provided by industry partners. Throughout the course, students receive coaching, individual mentoring, tutorials, and practical trainings on the use of machines and equipment (e.g., 3D printers, laser cutters, sensors, etc.).

Media:
Moodle; slides; handbook; physical events in the lab.

Reading List:
• Lewrick M, Link P, Leifer L. 2018. The design thinking playbook: Mindful digital transformation of teams, products, services, businesses, and ecosystems. John Wiley & Sons, 1. Edition
• Ridley M. 2020. How innovation works. Fourth Estate, 1. Edition
• Turrin R. 2019. Innovation lab excellence: Digital transformation from within. Authority Publishing, 1. Edition.

Responsible for Module:
Stich, Michael; Prof. Dr. rer. oec.

Courses (Type of course, Weekly hours per semester), Instructor:
Corporate Campus Challenge (Vorlesung, 4 SWS)
Stich M
For further information in this module, please click campus.tum.de or here.

Module Description

WIHN1198: Communication Skills | Communication Skills

Version of module description: Gültig ab winterterm 2019/20

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 30	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Students can choose between a number of courses addressing different communicative challenges. The examination is not graded (Studienleistung) and can be an oral assessment or a written exam. Please find detailed information regarding course examinations, content, learning outcomes, literature and teaching and learning methods in the individual course description (Lehrveranstaltungsbeschreibung) in TUMonline.

For example:
The oral assessment or presentation assess students' ability to transport their point of view in a comprehensible and well-structured manner. Students show that they can communicate scientific or business issues in a careful but effective way. They communicatively create a situation of mutuality independent of culture-specific particularities. Answering questions students show that they can advocate their angle on a topic using communication methods.

Please find the up-to-date information in which courses students may earn credits under the following link under communication skills: https://www.wi.tum.de/programs/bachelor-in-mt/downloads/.

Repeat Examination:
Next semester

(Recommended) Prerequisites:

Content:
Students can choose between a number of courses addressing different communicative challenges:

(1) Presentation & Moderation Techniques:
- use and effect of voice, language and body language
- managing the impact on employees and customers
- defining explicit goals and objectives
- responsibilities, role and self-perception of an facilitator
- strategies how to conduct a fruitful discussion

(2) Conflict Management & Conduct of Negotiations
- conflict types
- causes and development of conflicts
- systematic conflict analysis (e.g. stages of escalation after Glasl)
- conflict patterns
- concepts of negotiation strategies,
- conflict de-escalation

(3) Business Plan
- developing a business plan
- assessment of business ideas
- analyzing market & competition
- pitching business idea

(4) Intercultural Communication
- share information across different cultures and social groups
- interact with people from other cultures
- understand customs from people of different countries

(5) Language Courses
(offered by TUM Language Center or courses completed abroad equivalent to 3 ECTS)
- learn a foreign language
- be more open to another culture
- assessment of business ideas; analysing market & competition

Intended Learning Outcomes:
Upon successful completion of the module students are able to (1) efficiently and appropriately communicate business and scientific topics to others such as employees or an audience. (2) They are able to present and discuss complex issues referring to a scientific basis within groups or in front of an audience and (3) lead a discussion. Furthermore, they are able to (4) tackle conflict situations and (5) manage to communicatively find a solution.

Teaching and Learning Methods:
To sharpen their communication skills the focus in these courses is to practice in different situations and settings. Depending on the selected course, students will e.g. hold short presentations,

pitches or exercise in role-plays. To deepen and strengthen these learning experiences peers and instructors will give immediate feedback.

Media:
PowerPoint slides, moodle, videos, online learning materials

Reading List:
- Ant, Marc; Nimmerfroh, Maria Christina; Reinhard, Christina (2014); Effiziente Kommunikation - Theorie und Praxis am Beispiel “Die 12 Geschworenen”; Springer Gabler
- Alan Barker (2013); Improve Your Communication Skills; Kogan Page Publishers

Responsible for Module:
Stich, Michael; Prof. Dr. rer. oec.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Bachelor's Thesis | Bachelor's Thesis

Module Description

WIHN0693: Bachelor's Thesis | Bachelor's Thesis

Version of module description: Gültig ab winterterm 2019/20

Module Level: Bachelor	**Language:** German/English	**Duration:**	**Frequency:** winter/summer semester
Credits:* 12	**Total Hours:** 360	**Self-study Hours:** 360	**Contact Hours:**

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The Bachelor's Thesis is a final paper with a duration of 3 months, where the students concentrate on a specific topic in business administration and economics. Here the students frame the state of research and discourse and evolves the own specific topic. Based on scientific knowledge and methodical skills, students autonomously discribe the topic. The Bachelor's Thesis is supported by a professor of the TUM School of Management.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
The Thesis can be filed after the successfull completion of 87 Credits in the basics of business amdinistration and the project study.

Content:
The Bachelor's Thesis focuses on a research topic in business adminstration and economics, usually at the interface to engineering and natural sciences. The Thesis is always supervised by a professor of TUM School of Management, often in co-operation with an organization of industry or research. The topic of the Thesis is created so that it can be treated extensively within three months.

Intended Learning Outcomes:
At the end of the module "Bachelor's Thesis" students are able to handle and develop a project in an autonomic, systematic and scientific way. Therefore the students deploys scientific knowledge and methodical skills to the specific subject. They script the state-of-the-art knowledge, based on

research, and classify the findings within the scientific and/or practical discussion. The students are able to cope with new and complex subjects in an autonomous way.

Teaching and Learning Methods:
The creation of the thesis encourages the students to deal soundly with a scientific subject. Therefor they apply the knowledge and methodical skills, acquired during the studies, and create an elaborated scientific documentation within the set time frame.

Media:
literature, presentations

Reading List:
specific literature based on the topic

Responsible for Module:
Stich, Michael; Prof. Dr. rer. oec.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

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