<table>
<thead>
<tr>
<th>Course</th>
<th>Language</th>
<th>Description</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business, Technology &amp; Development of Passenger Car Tires</td>
<td>English</td>
<td>The course offers an introduction into automotive lighting technology and teaches the technological and physiological fundamentals which are necessary to understand and evaluate lighting systems. In detail students are taught • the role of light for human vision • the principle of light sources and light distribution systems • the influence of light sources and light distribution systems on human vision • the principle of light distribution systems • the influence of light distribution systems on human vision • the principle of light distribution systems • the influence of light distribution systems on human vision.</td>
<td>Wördner, B., Wördner, L., Beyen, P., Hoffn, D.: Automotive Lighting and Human Vision, Springer Berlin, Heidelberg 2013. Online available at link.springer.com</td>
</tr>
</tbody>
</table>
Applied elasticity theory in the aviation

Scientific Research Work:
Mechatronics lessons

Design and Simulation of Optomechanical Systems

Combustion Technology

Advanced Thermodynamics /ThermoLab

Laser Material Processing
Production of Optoelectronic Systems

Outcomes: This module gives basic knowledge about processes and devices that are used in the production of semiconductor packages and microsystems. The main focus is on those basics that people often use (e.g. silicon) and their characteristics. The module introduces different packaging techniques and explains the corresponding basics of each.

- Explain the production processes beginning from crude material and to have an idea about process-relevant parameters
- Visualize different packaging techniques and explain the corresponding basics of physics
- Choose and classify different package types for application

Contents:
- Wafer production
- Mechanical wafer treatment
- Mechanical connection methods (micro bonding, soldering, eutectic bonding)
- Electrical connection methods (wire bonding, flip chip bonding, TAB)
- Package types for semiconductors
- Testing and marking of packages
- Design and production of printed circuit boards
- Printed circuit board assembly and soldering techniques

Analyse von Deformationsmessungen

Institute for Umformtechnik und Umformmaschinen

Objectives: This lecture introduces the basic principles for the instruction of deformations measurement and numerical simulation work for the analysis of forming processes. Ability to apply digital design tools to solve problems related to forming technology.

- Understand the fundamentals for material characterization and numerical simulation work for the analysis of forming processes
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The lectures are given in English.

**Mensch-Roboter-Kollaboration**

- The students learn what a human-friendly robot is like.
- The students develop an understanding of the theoretical foundations of human-friendly technologies.
- The students learn the foundations of human-robot collaboration.
- The students learn the fundamentals of recent methods for globalizing planning in dynamic environments.

**Institut für Robotik & Kollaboration**

- A Mathematical Introduction to Robotics Manipulation: Richard M. Murray, Zexiang Li, S. Shankar Sastry
- Robot Modeling and Control: Mark W. Spong, Seth Hutchinson
- Lectures Notes: Advanced Robotics Manipulation

**V2/Ü1/L1**

- SS 62 88 mündlich
- Oussama Khatib: Inertial Properties in Robotics Human‐Robot‐Collaboration
- The students learn, what a human-friendly robot is like.
- The students know the foundations of robot control for human-robot interaction.
- The students have an overview of state-of-the-art reactive motion generation algorithms for collision avoidance.
- The students know the fundamentals of recent methods for globalizing planning in dynamic environments.

**Hands on experimentation with data mining tasks and algorithms through open source tools, like Weka, MOA, R, etc.**

**Institut für Robotik & Kollaboration**

- In the "Data Mining I" course, basic data mining tools and techniques are introduced.
- The course covers: data mining tasks; association mining; clustering techniques; classification techniques; regression techniques; data mining methods; data mining tools and environments.

**Institut für Verhaltenswissenschaft**

- Basic concepts in data mining/machine learning, Programming knowledge
- We will use different tools for the different topics covered in the lecture. The aim of the course is to introduce students to the field of data mining and knowledge discovery. The following topics will be covered:
- Data mining and knowledge discovery
- Parallel and distributed mining
- Data stream mining
- Ensemble learning
- Semisupervised methods and techniques for mining large complex datasets. This includes both adaptation of old data mining techniques to deal with new methods and techniques that were specifically developed for such tasks. The focus is on giving an overview of the field of data mining and knowledge discovery.

**Computing Systems**

- Data mining and knowledge discovery problems. Data modelling, entity-relationship diagrams, algebra, constraint and optimization problems.
- Operations of relation algebra. Simple queries, multiplication and union in SQL, attribute specification, queries intersection and subtraction, sub-queries implementation. Aggregation, grouping in SQL, tables modification, updating, tuples insertion and indexes creation. PL/SQL language for Oracle 8i. Wherever variables, contexts and transactions are used, possible problems, premature reading, unrepeatable reading, lost update, phantom problem, isolation level, locking, recovery, backup and restore. The applications of database design are given by Oracle PL/SQL programming.

**Distributed Databases**

- Distributed computing, parallel and distributed databases, workflows, OLAP systems (cubes mining), transaction management, concurrency control, deadlock avoidance, snapshot isolation, distributed updates, distributed lock manager.
- SQL database specification, queries interpretation and optimization, sub-query implementation. Aggregation, grouping in SQL, tables modification, updating, tuples insertion and indexes creation. PL/SQL language for Oracle 8i. Wherever variables, contexts and transactions are used, possible problems, premature reading, unrepeatable reading, lost update, phantom problem, isolation level, locking, recovery, backup and restore. The applications of database design are given by Oracle PL/SQL programming.

**History and Methodology of Informatics and Computer Science**

- The course deals with various directions of computer science history and development, such as history, evaluation and control of operating systems; event processing and threads control; history and the present state of relational and object-oriented databases; database networking and cloud services; traditional and modern logic and the theory of algorithms; machine and computer science; computer mathematics; numerical methods; algebraic calculation; programming language and technology development; machine graphs and multiuser systems.


- The assessment will be done by a course project and a examination.
Intelligent Computing

The objective of this course is to study the basic aspects of the field of modern computer science: computational intelligence, software and hardware of intelligent systems. During the course students will learn main technologies, approaches and methods of computational intelligence, basic modern aspects of artificial intelligence, and implement some computer and stokosystems for solving variable real-life tasks. Mandatory requirements: Pattern Recognition, Information Theory, Control System, Artificial Intelligence, Intelligent Systems, Intellect. Optional courses: Evolutionary Computing, Intelligent Hardware, Intelligent Software.

Intelligent Control Systems


Intelligent Systems

The purpose of the course is to prepare the student for practical activities in the field of creation, introduction and operation of intellectual systems. The goals of this course are to acquaint the student with brief history and development of artificial intellect; to consider technical statements of the primary goals solved by systems of artificial intellect; to acquaint with modern areas of research on artificial intellect; to consider theoretical and some practical questions of creation and operation of expert systems. 1. The theoretical problems solved by AI. 2. Practical application areas of AI methods. 3. Logic. 4. Production rules. 5. Languages of the description production models Prolog and Lisp. 6. Semantic networks.

Knowledge Management and Knowledge Engineering

The course will introduce the underlying theme of the new degree, methodological data structuring methodology for different domains. Knowledge engineering include the principles, position, issues, methods, techniques and programs involved in the knowledge elicitation, structuring and formalizing. 1. Elicit, structure and formalize knowledge acquired from different sources 2. Think creatively about and understand the strategic role of knowledge acquisition techniques in information processing and the role of information analysts in this area 3. Contribute to increasing the creativity and productivity of information processing and working with different information.

Mathematical Modelling and Simulation

1. Mathematical modeling is the basis of all simulation and designing of complex and dynamic real-world systems. The theory and the practice of mathematical modeling cover a wide range of problems in science, engineering, economics, and other fields. The course introduces the students to the fundamental concepts of mathematical modeling, including the formulation of mathematical models, the solution of mathematical models, and the interpretation of mathematical models. The course also covers the use of mathematical models in decision-making and problem-solving.

Methods of Optimization

The main objective of this course is to develop basic concepts of the optimization theory and numerical methods for solving optimization problems. The course provides the student with a number of numerical optimization techniques and gives examples of their application in technical and economic problems.

The Assessment will be done by a course project and a written examination.
Modern Problems of Computers and Information Science
Modern Problems of Computers and Information Science

The main objective of this course is to display fundamental concepts and new achievements of informational technologies and resources and their applications. Different fields of human activity. The course provides the productive knowledge of various optimization techniques playing an increasingly important role in controlling and planning, system analysis, decision, industrial automation, communications and management science.

1. Structure, formation and describe model-based model of practical problem
2. Choice and investigate corresponding optimization algorithm
3. Construct optimize analysis problem to select the best decision
4. Construct technical result and provide data analysis of optimal project.
5. Use popular scientific / software Matlab/MATLAB/GAMS/Emathlab, etc. for optimization based modeling and simulation

Modern Problems of Computers and Information Science


Scientific and Research Work

To the scientific and research work enable each student to pursue research techniques, literary review, academic discussion, scientific and the practical application of research knowledge. After completion of the course, each student becomes familiar with a current knowledge and assumes responsibility for a small project. The project is a complete individual project, with the student discovering the results in written form, giving a presentation and finally making an oral discussion on the subject.

Scientific and Research Work


Software Development Technology

Software Development Technology

In this course we focus on the application of planning theory and results for the design of software development systems and technologies, focusing on the performance predictions of manufacturing and service industries. First, we present a systematic approach to the management of software development projects. Then, we present the basic elements of the branch and bound method in a systematic way. Finally, we present the basic ideas of the branch and bound method in a systematic way.

Performance Analysis II: Manufacturing Systems Modeling and Analysis

Performance Analysis II: Manufacturing Systems Modeling and Analysis

This course covers fundamental methods to analyze stochastic systems and processes. The focus is on Markov models of manufacturing and service systems in both discrete and continuous time that are treated alternatively, in particular with respect to their steady state behavior. Birth-and-death processes, elementary Markovian queueing models and Little’s Law are treated in detail. The focus is on Markovian models of manufacturing and service systems in both discrete and continuous time that are treated alternatively, in particular with respect to their steady state behavior. Branch-and-bound methods and their use in model generation and optimization are covered.

Performance Analysis I: Stochastic Models in Production and Logistics

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Micro- and Nanosystems

Micro- and Nanosystems

Nano- and Nanoscale Physics

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Ensemble of problems constitutes the core of the materials science and engineering. The focus is on Markov models of manufacturing and service systems in both discrete and continuous time that are treated alternatively, in particular with respect to their steady state behavior. Birth-and-death processes, elementary Markovian queueing models and Little’s Law are treated in detail. Finally, fundamental elements of discrete-event simulation using general-purpose programming languages are covered.

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The laboratory can only be completed if the student has demonstrated knowledge of the Finite Elements Method. The laboratory is scheduled in the laboratory facilities at the Laboratory for Numerical Mathematics and Computer Science (LIM).
<table>
<thead>
<tr>
<th>Course Title</th>
<th>Language</th>
<th>Duration</th>
<th>Credits</th>
<th>Exam Type</th>
<th>Exam Date</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamentals of Lasers in Medicine and Biomedical Optics</td>
<td>English</td>
<td>V2 32h</td>
<td>5</td>
<td>mündlich</td>
<td>5/11</td>
<td>WS</td>
</tr>
<tr>
<td>Introduction to numerical methods in optics</td>
<td>English</td>
<td>V2 118h</td>
<td>5</td>
<td>mündlich</td>
<td>5/11</td>
<td>WS</td>
</tr>
<tr>
<td>Laser Interferometry</td>
<td>English</td>
<td>V2 32h</td>
<td>5</td>
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<tr>
<td>Laser Material Processing II</td>
<td>English</td>
<td>V2 118h</td>
<td>5</td>
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<td>5/11</td>
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<td>Laser Measurement Technology</td>
<td>English</td>
<td>V2 32h</td>
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**Fundamentals of Lasers in Medicine and Biomedical Optics**

The student will learn the fundamentals of laser-tissue interaction and will be introduced to coherence optics and the different aspects by clinically relevant examples and applications. Within tutorials and the block seminar (at the end of the semester), recent publications will be studied and discussed.

**Introduction to numerical methods in optics**

The lecture gives an introduction to and overview of the most popular numerical methods utilized in photonic systems.

**Laser Interferometry**

Students acquire knowledge of modern laser interferometry. The emphasis of the lecture is laid in laser interferometers for gravitational wave detection such as well as in laser interferometry on satellites.

**Laser Material Processing II**

The course covers the spectrum of laser technology in the production as well as the potential of laser technology for future applications. It covers the scientific and technical basics knowledge, which is used in the laser systems as well as the interaction of the laser beam with the material. On the basis of applications in subject areas such as micromachining, the required physical conditions for laser processing such as wavelength, pulse duration, and pulse energy are worked out and described in connection with the specific process, handling, and control technology. The purpose is to develop an understanding of the basics and the current demands for laser technology to provide access for the participants into laser technology in industry.

**Laser Measurement Technology**

The aim of this lecture course is to introduce to the basics of laser measurement technology based on laser sources. An overview of the various fields of laser sources, measurement techniques, and typical practical applications for various optical measurement, monitoring, and sensing situations in research and development will be provided. The exercise course aims at consolidating the understanding of the basics and provides theoretical exercises according to selected example applications and practical laboratory training.

**Notes:**

- Fundamentals of Quantum Optics
- Laser Interferometry: Basics of interferometry, construction, and applications
- Laser Material Processing II: Basics of laser material processing
- Laser Measurement Technology: Basics of laser sensors and measurement technology
- Laser Interferometry: Basics of interferometry and coherence optics
- Laser Material Processing II: Basics of laser material processing
- Laser Measurement Technology: Basics of laser sensors and measurement technology
### Laser Spectroscopy in Life Sciences
#### Basic Principles
- Springer, 2008
- Jürgen Heras: Bauformen Strahlführung Anwendungen (Springer), 2010
- Thomas Engell: Quantum Chemistry and Spectroscopy (Pearson), 2013

#### Nonlinear Optics
- Nonlinear Optics
- Shang, Nonlinear Optics, Wiley-Interscience
- Dmitriev, Handbook of nonlinear crystals, Springer

#### Nonlinearity
- Wave equation with nonlinear source terms
- Frequency doubling, sum-, difference frequency generation
- Optical parametric amplifier, cascaded
- Phase shifting schemes, space phase-matching
- Electro-optical effect
- Electro-acoustic modulation
- Frequency tagging, Kerr effect, self phase modulation, self-focusing
- Parametric amplification, non-linear mixing
- Nonlinear poling, solitons

### Numerical Methods and Simulation Strategies in Theoretical Physics
- H. Gould, J. Tobochnik, C. W. Wolfgang: An Introduction to Computer Simulation Methods, Addison-Wesley
- E. Binder, D. Herrmann: Monte Carlo Simulation in Statistical Physics, Springer-Verlag
- M. L. Lapidus: Algorithms, Fractals and Wavelets, Springer-Verlag
- H. P. Langtangen: A Primer on Scientific Programming with Python, Springer-Verlag

### Optical Coatings and Layers
- Optical Coatings and Layers
- Optical Coatings and Layers

### Optical Measurement Technology
- Optical Measurement Technology

### Optical properties of micro and nanostructures
- Optical properties of micro and nanostructures

### Photogrammetric Computer Vision
- Photogrammetric Computer Vision

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**Course Information:**
- **Lecturer:** [Name]
- **Time:** [Time]
- **Location:** [Location]
- **Credits:** [Credits]
- **Language:** [Language]
- **Prerequisites:**
- **Topics Covered:**
- **Required Readings:**
  - Hecht: Optics
  - Saleh, Teich: Fundamentals of Photonics
  - Lauterborn, Kurz: Coherent Optics
  - Goodman: Introduction to Fourier Optics
  - Demtröder: Experimentalphysik
  - David A. Forsyth and Jean Ponce (2003). Photogrammetric Computer Vision

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**Additional Notes:**
- [URL for additional resources or course materials]

---

**Contact:**
- [Instructor Contact Information]
- [Office Hours]

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**Evaluation:**
- [Grading Policy]
- [Exams]
- [Assignments]

---

**Schedule:**
- [Weekly Schedule]
- [Topics Covered Each Week]

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**Course Objectives:**
- [Course Objectives]
- [Learning Outcomes]

---

**Course Materials:**
- [List of course materials]
- [Links to online resources]
Physics of Solar Cells

Semiconductor equations, optical properties of semiconductors, transport of electrons and holes, carrier recombination mechanisms, narrow-gap semiconductor devices, characterization methods for solar cells, cell efficiencies and their implications for solar cell technology.

Physics of Solar Cells

Satellite Remote Sensing I

Basics: Satellite orbits, electromagnetic radiation and radiative transfer, remote sensing with satellite instruments, retrieval methods, inverse methods, remote sensing of the land masses, the oceans and the atmosphere. Theoretical exercises and practical exercises with real satellite data.

Satellite Remote Sensing II

Basics: Satellite orbits, electromagnetic radiation and radiative transfer, remote sensing with satellite instruments, retrieval methods, inverse methods, remote sensing of the land masses, the oceans and the atmosphere.

Solid State Lasers

Basic knowledge in physics and related applications.

Ultrafast Laser Pulses

Basic knowledge in physics and related applications.

Ultrashort Laser Pulses

Basic knowledge in physics and related applications.

Solid State Lasers

Basic knowledge in physics and related applications.

Satellite Remote Sensing II

Basic knowledge in physics and related applications.

Satellite Remote Sensing I

Basic knowledge in physics and related applications.

Physics of Solar Cells

Basic knowledge in physics and related applications.

Physics of Solar Cells

Basic knowledge in physics and related applications.

Ultrashort Laser Pulses

Basic knowledge in physics and related applications.

Satellite Remote Sensing I

Basic knowledge in physics and related applications.

Satellite Remote Sensing II

Basic knowledge in physics and related applications.

Solid State Lasers

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Ultrafast Laser Pulses

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Satellite Remote Sensing I

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Satellite Remote Sensing II

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Solid State Lasers

Basic knowledge in physics and related applications.

Ultrafast Laser Pulses

Basic knowledge in physics and related applications.

Satellite Remote Sensing I

Basic knowledge in physics and related applications.
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<th>Course Code</th>
<th>Course Title</th>
<th>Language</th>
<th>Units</th>
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<td>Global Electronic Business</td>
<td>Englisch</td>
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<td>Institut für Wirtschaftsinformatik&lt;br&gt; Primarily PPT-slides, further references are given individually from the supervisors.</td>
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<td>Strategic International Management</td>
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</table>

**Global Electronic Business**<br>Students understand the importance and usage of Electronic Business, information systems (IS) and information technology (IT) in globally present companies. They understand the most important terms and can use the technical language. They know basic methods and models of Electronic Business supported and enabled by IS, IT and the Internet. Moreover students understand typical Electronic Business processes, characteristics and specifications, e.g., E-Commerce, M-Business and M-Commerce, and M-Collaboration.<br>The students get familiar with specified International topics such as mobile and food economics in a wider sense. Eating and drinking behaviors play a different role for business between countries and cultural borders. The students learn about changing International trading patterns along with different marketing strategies andregulation cultures at the entrepreneurial level. The cultural differences also affect the sustainability and upgrading of national and International value chains with effective issues coming increasingly into the play. Against this background, the students get familiar with relevant International and cultural aspects of International issues. The essay may be based on online surveys conducted in and comparing between different countries.<br><br>**Intercultural Economics and Management**<br>The study of Intercultural Economics and Management provides a broad understanding of current development trends of global markets for both consumers and companies. An general understanding of global markets is necessary to enable students to analyze specific issues occurring in international business contexts and to develop sustainable solutions in the subjects addressed. To do so, the lecture combines methodical approaches and practical case studies in the control of cross-cultural management.<br><br>**International Marketing**<br>The course International Marketing provides a broad understanding of current development trends of global markets for both consumers and companies. A general understanding of global markets is necessary to enable students to analyze specific issues occurring in international business contexts and to develop sustainable solutions in the subjects addressed. To do so, the lecture combines methodical approaches and practical case studies in the control of cross-cultural management.<br><br>**Strategic International Management**<br>The students will be introduced to some fundamental concepts, frameworks and models of Strategic and International Management. The course connects state of the art research with practical questions of companies operating in an competitive and international environment. Students will reflect on effective management, strategy, alliances and networks, appropriate leadership styles and decision making behaviour in international companies and develop respective management skills.