<table>
<thead>
<tr>
<th>Module</th>
<th>Code</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Databases</td>
<td>CS2700, DB</td>
<td>1</td>
</tr>
<tr>
<td>Introduction to Bioinformatics</td>
<td>CS1400, EinBioinfo</td>
<td>3</td>
</tr>
<tr>
<td>Robotics</td>
<td>CS2500, Robotik</td>
<td>5</td>
</tr>
<tr>
<td>Electronics and Microsystems</td>
<td>CS3120, EIMi</td>
<td>6</td>
</tr>
<tr>
<td>Basic Chemistry</td>
<td>LS1100-INF, ChemInf</td>
<td>8</td>
</tr>
<tr>
<td>OS MLS: Part of the module G: Life: naturally artificial</td>
<td>LS2800G, WPBScEth</td>
<td>9</td>
</tr>
<tr>
<td>Clinical Studies</td>
<td>MA2214, KlinStud</td>
<td>11</td>
</tr>
<tr>
<td>Einführung in biologische Labortechniken für Ingenieure</td>
<td>ME2200, EBL</td>
<td>13</td>
</tr>
<tr>
<td>Basics of hygiene and sterilisation</td>
<td>ME2300, HUS</td>
<td>14</td>
</tr>
</tbody>
</table>

### 1. and 2. term

**Introduction to Medicine** (MZ2150, EMed)

### 1. Term

- **Linear Algebra and Discrete Structures 1** (MA1000, LADS1)
- **Analysis 1** (MA2000, Ana1)
- **Physics 1** (ME1010, Phy1)
- **Module Part: Course Anatomy** (MZ2100 A, Anatomie)
- **Module Part: Course Pathology** (MZ2100 B, Patho)
- **Grundlagen der Medizin 1** (MZ2100-MIW, GMed1)

### 2. Term

- **Linear Algebra and Discrete Structures 2** (MA1500, LADS2)
- **Analysis 2** (MA2500, Ana2)
- **Analysis 2** (MA2502-MIW, Ana2)
- **Physics 2** (ME1020, Physik2)
- **Einführung in die Medizintechnik** (ME1550, EinMedtec)
- **Module Part: Course Physiology** (MZ2100 D, Physio)
- **Module Part: Course Cell Biology and Genetics** (MZ2100 E, Zellbio)
- **Grundlagen der Medizin 2** (MZ2500-MIW, GMed2)

### 3. Term

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4. Term
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<td>Gesundheitsökonomie</td>
<td>ME3140</td>
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<tr>
<td>Medical Quality Management</td>
<td>MZ3100</td>
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<td><strong>6. Term</strong></td>
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<tr>
<td>Embedded Systems</td>
<td>CS2101</td>
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<tr>
<td>Computer Networks</td>
<td>CS2150</td>
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<td>Artificial Intelligence 1</td>
<td>CS3204</td>
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<tr>
<td>Neuro-informatics</td>
<td>CS4405</td>
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<td>Organic Chemistry</td>
<td>LS1600</td>
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<td>Biostatistics 1</td>
<td>MA1600</td>
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<tr>
<td>Optimization</td>
<td>MA4030</td>
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<tr>
<td>Numerics 2</td>
<td>MA4040</td>
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<tr>
<td>Lasers in Medicine</td>
<td>ME2101</td>
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<tr>
<td>Bachelor Seminar MIW</td>
<td>ME3702</td>
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<tr>
<td>Bachelorarbeit Medizinische Ingenieurwissenschaft</td>
<td>ME3990</td>
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<tr>
<td>Radiologie, Nuklearmedizin, Strahlentherapie</td>
<td>MZ3160</td>
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<tr>
<td><strong>Arbitrary semester</strong></td>
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<tr>
<td>English for Bachelor and Master students</td>
<td>PS1030</td>
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<tr>
<td>Start-up and New Business</td>
<td>PS5830</td>
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**CS2700 - Databases (DB)**

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>Each summer semester</td>
<td>4</td>
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</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor MES (Optional Subject)
- Bachelor Medical Informatics SJ14 (compulsory), 4. Term
- Bachelor Media Informatics SJ14 (compulsory), Computer Science Basics, 4. Term
- Bachelor Computer Science (compulsory), Computer Science Basics, 4. Term
- Bachelor Medical Informatics (compulsory), 2. Term
- Master MML (choice), 2. Term
- Bachelor MML (choice), 6. Term
- Bachelor Computer Science (compulsory), Computer Science Basics, 4. Term

**Classes and lectures:**
- Databases (Lecture, 2 SWS)
- Databases (Exercise, 1 SWS)

**Workload:**
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

**Contents of teaching:**
- ...

**Qualification-goals/Competencies:**
- ...

**Grading through:**
- Exercises
- Test

**Is requisite for:**
- Nonstandard Database Systems (CS3202)

**Requires:**
- Introduction to Programming (CS1000SJ14)
- Algorithms and Data Structures (CS1001)
- Programming (CS1000)

**Teacher:**
- Institute of Information Systems
- Prof. Dr. Volker Linnemann
- Nachfolger von Prof. Linnemann

**Literature:**
Language:
- Offered only in German
# CS1400 - Introduction to Bioinformatics (EinBioinfo)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
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<tbody>
<tr>
<td>Turnus of offer:</td>
<td>Each winter semester</td>
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<tr>
<td>Credit points:</td>
<td>4</td>
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</table>

## Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory), medical computer science, 3. Term
- Bachelor Computer Science (compulsory), Enhanced course Biology & IT, 1. Term
- Bachelor Medical Informatics (compulsory), medical computer science, 3. Term
- Bachelor MLS (compulsory), Life Sciences, 5. Term
- Bachelor MML (compulsory), Enhanced course Biology & IT, 5. Term
- Bachelor MES (Optional Subject), Medical Engineering Sciences
- Bachelor Computer Science (compulsory), Enhanced course Biology & IT, 1. Term

## Classes and lectures:
- Introduction to Bioinformatics (Lecture, 2 SWS)
- Introduction to Bioinformatics (Exercise, 1 SWS)

## Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

## Contents of teaching:
- Life, genes & gene evolution
- Structure of the human DNA
- Sequence assembly - Industrial reading of genetic information
- DNA sequence models & hidden markov models
- Sequence alignment & dynamic programming
- DNA microarrays & GeneChip technologies
- Introduction into systems biology
- The human brain
- Neural networks / multilayer perzeptrons
- Supervised & unsupervised learning

## Qualification-goals/Competencies:
- Basic understanding of DNA and the coding of genetic information
- Principles of probabilistic modeling
- Application of basic algorithms for the analysis of genetic sequences
- Basic techniques and methods for the processing of genetic information
- Introduction to bioinformatic databases
- Basic understanding of Microarrays and GeneChip-Technologies
- Understanding the challenges of systems biology
- Principles of information processing in nervous systems
- Building a bridge between machine and biological (Hebbian) learning

## Grading through:
- Exercises
- Test or Viva voce, made available by the lecturer

## Responsible for this module:
- Prof. Dr. rer. nat. Amir Madany Mamlouk
- Prof. Dr. rer. nat. Thomas Martinetz

## Teacher:
- Institute for Neuro- and Bioinformatics
- Prof. Dr. rer. nat. Amir Madany Mamlouk

## Literature:
<table>
<thead>
<tr>
<th>Books</th>
</tr>
</thead>
<tbody>
<tr>
<td>M. S. Waterman: Introduction to Computational Biology - Chapman and Hall, 1995</td>
</tr>
</tbody>
</table>

**Language:**
- Offered only in German

**Notes:**
- For students of the master programme Infection Biology, this is not a stand-alone module, but rather part of the module CS4011.
- Computer Science students get a B certificate.
<table>
<thead>
<tr>
<th>Course of study, specific field and term:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Bachelor Medical Informatics (Optional Subject), Applied Computer Science</td>
</tr>
<tr>
<td>• Bachelor Computer Science (Optional Subject), Informatics central topics, 5. Term</td>
</tr>
<tr>
<td>• Master MML (choice), 3. Term</td>
</tr>
<tr>
<td>• Bachelor MES (Optional Subject), Medical Engineering Sciences</td>
</tr>
<tr>
<td>• Bachelor Computer Science (compulsory), Enhanced course robotics and automation, 3. Term</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classes and lectures:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Robotics (Lecture, 2 SWS)</td>
</tr>
<tr>
<td>• Robotics Exercise (Exercise, 1 SWS)</td>
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</table>

<table>
<thead>
<tr>
<th>Contents of teaching:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Basics of robotics</td>
</tr>
<tr>
<td>• Subsystems of robots</td>
</tr>
<tr>
<td>• Basics of kinematics</td>
</tr>
<tr>
<td>• Path planning</td>
</tr>
<tr>
<td>• Inverse kinematics</td>
</tr>
<tr>
<td>• Geometric algorithms</td>
</tr>
<tr>
<td>• Task-oriented systems</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Qualification-goals/Competencies:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Problem solving in team work</td>
</tr>
<tr>
<td>• Acquire solutions in due time</td>
</tr>
<tr>
<td>• Ability to discrete work using technical literature</td>
</tr>
<tr>
<td>• Robot kinematics and applications in medicine</td>
</tr>
<tr>
<td>• Robot programming</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grading through:</th>
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<tbody>
<tr>
<td>• Test</td>
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<table>
<thead>
<tr>
<th>Is requisite for:</th>
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<tbody>
<tr>
<td>• Practical Robotics and Automation (CS3501)</td>
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<table>
<thead>
<tr>
<th>Requires:</th>
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<tbody>
<tr>
<td>• Introduction to Robotics and Automation (CS1500)</td>
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<table>
<thead>
<tr>
<th>Responsible for this module:</th>
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</thead>
<tbody>
<tr>
<td>• Dr. rer. nat. Floris Ernst</td>
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<table>
<thead>
<tr>
<th>Teacher:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Institute for Robotics and Cognitive Systems</td>
</tr>
<tr>
<td>• Prof. Dr.-Ing. Achim Schweikard</td>
</tr>
<tr>
<td>• Dr. rer. nat. Floris Ernst</td>
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<table>
<thead>
<tr>
<th>Literature:</th>
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<tbody>
<tr>
<td>• M. Spong et al.: Robot Modeling and Control - Wiley &amp; Sons, 2005</td>
</tr>
<tr>
<td>• S. Lavalle: Planning Algorithms - Cambridge University Press, 2006</td>
</tr>
<tr>
<td>• Achim Schweikard: Skript zur Robotik Vorlesung</td>
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<table>
<thead>
<tr>
<th>Language:</th>
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<tbody>
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<td>• Offered only in German</td>
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## CS3120 - Electronics and Microsystems (ElMi)

<table>
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<tr>
<th>Duration:</th>
<th>1 Semester</th>
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</thead>
<tbody>
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<td>Turnus of offer:</td>
<td>Each winter semester</td>
</tr>
<tr>
<td>Credit points:</td>
<td>4</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Master MES (Optional Subject), Mathematics, 1. Term
- Master MES (Consolidating), 1. Term
- Bachelor Computer Science (Optional Subject), Informatics central topics, 5. or 6. term
- Bachelor MES (Optional Subject), Medical Engineering Sciences
- Bachelor Computer Science (compulsory), Enhanced course robotics and automation, 5. Term

### Classes and lectures:
- Electronics and Microsystems (Lecture, 2 SWS)
- Electronics and Microsystems (Exercise, 1 SWS)

### Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

### Contents of teaching:
- Analysis of DC-networks
- Transient analysis in the time-domain
- Network analysis in the frequency domain
- Passive filters
- Oscillator circuits
- Bipolar transistors
- Field-effect transistors
- Amplifiers
- Operational amplifiers
- Active filters
- Digital-analog converters
- Analog-digital converters
- Phase-locked loops
- Introduction to Microsystems engineering
- Materials used in Microsystems
- Manufacturing technologies

### Qualification-goals/Competencies:
- Students know the most important electronic components and corresponding basic circuits
- They are qualified to design and analyze basic active and passive electronic circuits
- They have basic knowledge about the methods of Microsystems engineering and its application areas

### Grading through:
- Exercises
- Test

### Requires:
- Fundamentals of Computer Engineering (CS1200)

### Teacher:
- Institute of Computer Engineering
- Prof. Dr.-Ing. Erik Maehle

### Literature:
- H. Hartl, E. Krasser, W. Pribyl, P. Söser, G. Winkel: Elektronische Schaltungstechnik; Perason Studium
- Tietze, U.; Schenk, Ch.; Gamm, E.: Halbleiter-Schaltungstechnik - Berlin: Springer 2012

### Language:
• Offered only in German
<table>
<thead>
<tr>
<th>Module Guide</th>
</tr>
</thead>
</table>

**LS1100-INF - Basic Chemistry (ChemINF)**

| Duration: 1 Semester | Turnus of offer: Each winter semester | Credit points: 4 |

**Course of study, specific field and term:**
- Bachelor Medical Informatics SJ14 (Optional Subject), medical computer science, 5. or 6. term
- Bachelor Computer Science (compulsory), Enhanced course Biology & IT, 3. Term
- Bachelor MES (Optional Subject)
- Bachelor Medical Informatics (Optional Subject), Biology & IT
- Bachelor Computer Science (compulsory), Enhanced course Biology & IT, 3. Term

**Classes and lectures:**
- Basic Chemistry (Lecture, 2 SWS)
- Basic Chemistry (Exercise, 1 SWS)

**Workload:**
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

**Contents of teaching:**
- Organisation of matter and the periodic table of the elements
- Chemical bonds, molecules and ions
- Chemical formula and stoichiometry
- The three-dimensional structure of molecules: From the VSEPR model to molecular orbitals
- Special properties of water
- Chemical Equilibrium
- Acids and Bases
- Redox reactions and electrochemistry
- Complexes and metal-ligand bonds
- Interactions between matter and radiation - Spectroscopy
- Thermodynamics
- Chemical Kinetics

**Qualification-goals/Competencies:**
- Understanding basic chemical concepts
- Basics of anorganic chemistry

**Grading through:**
- Test

**Responsible for this module:**
- PD Dr. phil. nat. Thomas Weimar

**Teacher:**
- Institute of Chemistry
- Institute of Medical Engineering
- Dr. Kerstin Lüdtke-Buzug
- PD Dr. phil. nat. Thomas Weimar

**Literature:**
- Schmuck et al.: Chemie für Mediziner - Pearson Studium
- Binnewies et al.: Allgemeine und Anorganische Chemie - Spektrum

**Language:**
- Offered only in German
| Duration: 1 Semester | Turnus of offer: Each winter semester | Credit points: 4 |

**Course of study, specific field and term:**
- Bachelor MES (Optional Subject)
- Bachelor MLS (Optional Subject), Life Sciences, 4. Term

**Classes and lectures:**
- Life: naturally artificial. Philosophy, History and Ethics of synthetic Biology (Seminar en blocque, 3 SWS)
- 70 Hours Private studies
- 45 Hours Presence studies

**Contents of teaching:**
- In 2010 the group of J. Craig Venter achieved a break-through in synthetic biology: the creation of living bacteria in a laboratory (with a natural model). Synthetic biology is an ambitious branch of biotechnology, which poses the question of the producibility of Life. This course will help to develop the skills needed to illuminate (in philosophical, historical, ethical and social aspects) the new situation created in the life sciences.
- Visions of artificial humans and artificial life. Film analysis: The Blade Runner (1982) and Frankenstein (1931). Is life necessarily natural? Is there a life of machines? What will change wen we can make artificial living beings? What is artificial? What do we mean when we say: something is alive?
- Philosophical approaches to life itself, the concepts of an organism, nature and technology. What can experiments demonstrate? Interpretation and construction of knowledge, the processes of fabrication of knowledge in laboratory practice. Texts, observations and experiments in different historical times.
- Ethical implications of concepts of life and synthetic biology: Risk analysis of gene technology, recent debates about artificial life, redesigning humans, enhancement and transhumanism. Coming to terms with social and biopolitical aspects of the life sciences.

**Qualification-goals/Competencies:**
- Understanding of basic philosophical aspects in Biology, especially in the Area of synthetic Biology
- Basic understanding of the history of concepts of life
- Expertise in attending ethical discussions in public

**Grading through:**
- Regular and successful participation
- Oral presentation and essay

**Responsible for this module:**
- Prof. Dr. phil. Christoph Rehmann-Sutter

**Teacher:**
- Institute for the History of Medicine and Science Studies
- Prof. Dr. phil. Christoph Rehmann-Sutter
- Prof. Dr. med. Cornelius Borck
- Prof. Dr. rer. nat. Burghard Weiss

**Literature:**
- Special Section “Synthetic Biology” - Science 333(2011): 1235-1256
- J. Boldt, O. Müller, G. Maio: Synthetische Biologie - Bern 2009
- K. Köchy: Biophilosophie zur Einführung - Hamburg 2008

**Language:**
- Offered only in German
Notes:

Basics understanding of molecular Biology; Interest in philosophical-ethical questions in the life sciences
# Module Guide
## MA2214 - Clinical Studies (KlinStud)

| Duration: | 1 Semester | Turnus of offer: | Every second winter semester | Credit points: | 4 |

### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (Optional Subject), medical computer science, 5. or 6. term
- Master Computer Science (Optional Subject), Enhanced course medical computer science, 3. Term
- Bachelor Medical Informatics (Optional Subject), medical computer science
- Bachelor MES (Optional Subject), Life Sciences
- Bachelor MML (compulsory), Mathematics

### Classes and lectures:
- Clinical Studies (Lecture, 2 SWS)
- Clinical Studies (Exercise, 1 SWS)

### Workload:
- 60 Hours Self studies and exercises
- 45 Hours Presence studies
- 15 Hours Test preparation

### Contents of teaching:
- Introduction to clinical trials
- Directives and study documents
- Statistical design
- Clinical investigation plan
- Case Report Form (CRF)
- Quality assurance and quality control, monitoring
- Data management and study data base
- Software applicable in clinical trials
- Analysis, clinical investigation report and publication

### Qualification-goals/Competencies:
- Understanding of regulatory issues of clinical trials - cooperation of involved participants and organisations
- Basic knowledge of processes in clinical trials before, during and after performing
- Fundamental knowledge of study documents
- Insight into IT requirements of clinical trials

### Grading through:
- Test

### Requires:
- Biostatistics 1 (MA1600)

### Responsible for this module:
- Dr. sc. hum. Katja Krockenberger

### Teacher:
- Centre for Clinical Studies
- Institute of Medical Biometry and Statistics
- Dr. sc. hum. Katja Krockenberger
- Andere Dozenten

### Literature:

### Language:
Offered only in German
<table>
<thead>
<tr>
<th><strong>Module Guide</strong></th>
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<tbody>
<tr>
<td><strong>ME2200 - Einführung in biologische Labortechniken für Ingenieure (EBL)</strong></td>
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<th>Duration:</th>
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<th>Credit points:</th>
<th>Max. group size:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>Each winter semester</td>
<td>4</td>
<td>6</td>
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</table>

**Course of study, specific field and term:**
- (Optional Subject), Medical Engineering Sciences
- Bachelor MES (Optional Subject)

**Classes and lectures:**
- Einführung in biologische Labortechniken (Lecture, 2 SWS)
- Einführung in biologische Labortechniken (Exercise, 1 SWS)

**Workload:**
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

**Contents of teaching:**

**Qualification-goals/Competencies:**

**Grading through:**
- Oral presentation and written report
- Regular and successful participation in the course

**Responsible for this module:**
- Dr. rer. nat. Ramtin Rahmazadeh

**Teacher:**
- Institute of Biomedical Optics

**Language:**
- Offered only in German
<table>
<thead>
<tr>
<th><strong>ME2300 - Basics of hygiene and sterilisation (HUS)</strong></th>
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<tbody>
<tr>
<td><strong>Duration:</strong> 1 Semester</td>
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</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor MES (Optional Subject)

**Classes and lectures:**
- Basics of hygiene and sterilisation (Lecture, 2 SWS)
- Basics of hygiene and sterilisation (practical course, 2 SWS)

**Workload:**
- 55 Hours Presence studies
- 50 Hours Work on project
- 15 Hours Test preparation

**Contents of teaching:**
- Microbiology: Bacteria, unicellular organisms, viruses, fungi □ general understanding, diagnostics, therapyBasics of immunologyHygiene: Transmission of disease, Disinfection, sterilization, epidemiology

**Qualification-goals/Competencies:**
- Acquisition of general knowledge on microorganisms as pathogens, Recognition and evaluation of infectious hazards, knowledge of preventative activity.
- Acquisition of techniques in collecting and processing microbiological samples, in identification of microorganisms and several disinfection arrangements
- Recognition, control and avoidance of infections

**Grading through:**
- Written elaboration
- Regular and successful participation in the course
- Test

**Responsible for this module:**
- PD Dr. rer. nat. Dagmar Willkomm

**Teacher:**
- Institute for Medical Microbiology and Hygiene
- Dr. med. Amrit Jarchow
- PD Dr. rer. nat. Dagmar Willkomm
- Elisabeth Johannsen

**Literature:**
- Kayser et al.: Taschenlehrbuch Medizinische Mikrobiologie - Thieme Verlag

**Language:**
- Offered only in English
# MZ2150 - Introduction to Medicine (EMed)

<table>
<thead>
<tr>
<th>Duration:</th>
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<tbody>
<tr>
<td>2 Semester</td>
<td>Each winter semester</td>
<td>12</td>
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</table>

## Course of study, specific field and term:
- Bachelor MES (compulsory), Medical Engineering Sciences, 1. and 2. term
- Bachelor Medical Informatics (compulsory), medical computer science, 1. and 2. term

## Classes and lectures:
- MZ2100 A: Anatomie (Course, 2 SWS)
- MZ2100 B: Pathologie (Course, 2 SWS)
- MZ2100 D: Physiologie (Course, 2 SWS)
- MZ2100 E: Zellbiologie und Genetik (Course, 2 SWS)

## Workload:
- 180 Hours Private studies
- 120 Hours Presence studies
- 60 Hours Test preparation

## Contents of teaching:
- See individual module parts

## Grading through:
- Test

## Responsible for this module:
- Prof. Dr. med. Hartmut Gehring
- Prof. Dr. rer. nat. habil. Heinz Handels

## Teacher:
- Institute for Biology
- Institut of Physiology
- Department of Pathology
- Institute of Anatomy

## Language:
- Offered only in German
# Module Guide

## MA1000 - Linear Algebra and Discrete Structures 1 (LADS1)

<table>
<thead>
<tr>
<th>Duration:</th>
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<tbody>
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<td>Turnus of offer:</td>
<td>Each winter semester</td>
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<tr>
<td>Credit points:</td>
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</table>

### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory: aptitude test), Mathematics, 1. Term
- Bachelor Media Informatics SJ14 (compulsory: aptitude test), Mathematics, 1. Term
- Bachelor Computer Science (compulsory: aptitude test), Mathematics, 1. Term
- Bachelor Medical Informatics (compulsory: aptitude test), Mathematics, 1. Term
- Bachelor Computer Science (compulsory: aptitude test), Mathematics, 1. Term
- Bachelor MES (compulsory), Mathematics, 1. Term
- Bachelor MML (compulsory), Mathematics, 1. Term

### Classes and lectures:
- Linear Algebra and Discrete Structures 1 (Lecture, 4 SWS)
- Linear Algebra and Discrete Structures 1 (Exercise, 2 SWS)

### Workload:
- 125 Hours Private studies
- 90 Hours Presence studies
- 25 Hours Test preparation

### Contents of teaching:
- Basics (logic, sets, mappings, relations, orders)
- Groups, rings, fields (including permutations, cosets, complex numbers)
- Vector spaces (basis, dimension, scalar product, norm)
- Matrices
- Linear systems of equations

### Qualification-goals/Competencies:
- Knowledge of basic mathematical thought and proof techniques
- Understanding of abstract structures
- Basic knowledge for the whole mathematical education
- Theory formation and model building competence

### Grading through:
- Exercises
- Test

### Responsible for this module:
- Prof. Dr. Jan Modersitzki

### Teacher:
- Institute of Mathematics and Image Computing
- Prof. Dr. Jan Modersitzki

### Literature:
- G. Strang: Lineare Algebra - Springer 2003
- K. Jänich: Lineare Algebra - Springer 2002
- D. Lau: Algebra und diskrete Mathematik I + II - Springer 2004

### Language:
- Offered only in German
<table>
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**Course of study, specific field and term:**
- Bachelor Medical Informatics SJ14 (compulsory), Mathematics, 1. Term
- Bachelor Media Informatics SJ14 (compulsory), Mathematics, 1. Term
- Bachelor Computer Science (compulsory), Mathematics, 1. Term
- Bachelor Medical Informatics (compulsory), Mathematics, 3. Term
- Bachelor MML (compulsory), Mathematics, 1. Term
- Bachelor MES (compulsory), Mathematics, 1. Term
- Bachelor Computer Science (compulsory), Mathematics, 3. Term

**Classes and lectures:**
- Analysis 1 (Lecture, 4 SWS)
- Analysis 1 (Exercise, 2 SWS)

**Workload:**
- 125 Hours Private studies
- 90 Hours Presence studies
- 25 Hours Test preparation

**Contents of teaching:**
- Sequences and series
- Functions and continuity
- Differentiability, Taylor series
- Multivariate differential calculus

**Qualification-goals/Competencies:**
- Teaching the basics of mathematical thought
- The students learn to understand fundamental terms of analysis such as convergence, continuity, differentiability
- The students acquire secure competence in using terms, equations, inequations, functions
- The students learn to apply different proof techniques

**Grading through:**
- Exercises
- Test

**Is requisite for:**
- Analysis 2 (MA2500)

**Responsible for this module:**
- Prof. Dr. rer. nat. Jürgen Prestin

**Teacher:**
- Institute for Mathematics
- Prof. Dr. rer. nat. Jürgen Prestin

**Literature:**
- K. Fritzsche: Grundkurs Analysis 1 +2
- H. Heuser: Lehrbuch der Analysis 1+2

**Language:**
- Offered only in German
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<th>Module Guide</th>
<th>ME1010 - Physics 1 (Phy1)</th>
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<td>● Physics 2 (ME1020)</td>
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<td><strong>Responsible for this module:</strong></td>
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<tr>
<td>● Buzug, Prof. Dr. rer. nat. Thorsten, Hübner, Prof. Dr. rer. nat Christian, Vogel, Prof. Dr. rer. nat Alfred</td>
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<td><strong>Teacher:</strong></td>
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<tr>
<td>● Institute of Biomedical Optics</td>
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<td>● Institute of Physics</td>
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<tr>
<td>● Institute of Medical Engineering</td>
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<tr>
<td>● Prof. Dr. rer. nat. Thorsten Buzug</td>
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<tr>
<td>● Prof. Dr. rer. nat. Christian Hübner</td>
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<tr>
<td>● PD Dr. rer. nat. Hauke Paulsen</td>
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<tr>
<td>● Prof. Dr. rer. nat. Alfred Vogel</td>
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## MZ2100 A - Module Part: Course Anatomy (Anatomie)

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### Course of study, specific field and term:
- (compulsory), Medicine, 1. Term
- Bachelor Medical Informatics SJ14 (compulsory), medical computer science, 1. Term
- Bachelor Medical Informatics (compulsory), medical computer science, 1. Term
- Bachelor MES (compulsory), Medicine, 1. Term
- Bachelor Computer Science (compulsory), Enhanced course medical computer science, 3. Term

### Classes and lectures:
- Anatomy (Lecture, 2 SWS)

### Workload:
- 45 Hours Private studies
- 30 Hours Presence studies
- 15 Hours Test preparation

### Contents of teaching:
- 
- 
- 

### Qualification-goals/Competencies:
- 
- 

### Grading through:
- Test

### Teacher:
- Institute of Anatomy
- Prof. Dr. med. Jürgen Westermann

### Literature:
- :
- :

### Language:
- Offered only in German
### MZ2100 B - Module Part: Course Pathology (Patho)

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<tbody>
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<td>Each winter semester</td>
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#### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory), medical computer science, 3. Term
- (compulsory), Medicine, 1. Term
- Bachelor Medical Informatics (compulsory), medical computer science, 1. Term
- Bachelor MES (compulsory), Medicine, 1. Term
- Bachelor Computer Science (compulsory), Enhanced course medical computer science, 3. Term

#### Classes and lectures:
- Pathology (Lecture, 2 SWS)

#### Workload:
- 45 Hours Private studies
- 30 Hours Presence studies
- 15 Hours Test preparation

#### Contents of teaching:
- 
- 
- 

#### Qualification-goals/Competencies:
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- 
- 

#### Grading through:
- Test

#### Teacher:
- Department of Pathology
- Prof. Dr. med. Alfred C. Feller

#### Literature:
- :
- :
- :

#### Language:
- Offered only in German
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<th>Turnus of offer:</th>
<th>Each winter semester</th>
<th>Credit points:</th>
<th>4</th>
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**Course of study, specific field and term:**
- Bachelor MES (compulsory), Medical Engineering Science (expiring), 1. Term

**Classes and lectures:**
- MZ2100 C (Course, 1 SWS)
- MZ2100 A (Course, 3 SWS)

**Workload:**
- 50 Hours Private studies
- 45 Hours Presence studies
- 25 Hours Test preparation

**Contents of teaching:**
- 

**Qualification-goals/Competencies:**
- 
- 
- 

**Grading through:**
- Test or Viva voce, made available by the lecturer

**Teacher:**
- Institute of Anatomy
- Prof. Dr. med. Jürgen Westermann
- Dr. med. Reinhard Eggers

**Language:**
- Offered only in German

**Literature:**
- 
- 

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**MZ2100-MIW - Grundlagen der Medizin 1 (GMed1)**
<table>
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<th>MA1500 - Linear Algebra and Discrete Structures 2 (LADS2)</th>
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<td><strong>Turnus of offer:</strong> Each summer semester</td>
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<td><strong>Credit points:</strong> 8</td>
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**Course of study, specific field and term:**
- (compulsory), Mathematics, 2. Term
- Bachelor Computer Science (compulsory: aptitude test), Mathematics, 2. Term
- Bachelor Medical Informatics (compulsory), Mathematics, 2. Term
- Bachelor MML (compulsory), Mathematics, 2. Term
- Bachelor MES (compulsory), Mathematics, 2. Term
- Bachelor Computer Science (compulsory: aptitude test), Mathematics, 2. Term
- Bachelor Medical Informatics SJ14 (compulsory), Mathematics, 2. Term

**Classes and lectures:**
- Linear Algebra and Discrete Structures 2 (Lecture, 4 SWS)
- Linear Algebra and Discrete Structures 2 (Exercise, 2 SWS)

**Workload:**
- 125 Hours Private studies
- 90 Hours Presence studies
- 25 Hours Test preparation

**Contents of teaching:**
- Determinants
- Linear mappings
- Coding theory (introduction and applications)
- Orthogonality
- Eigenvalues

**Qualification-goals/Competencies:**
- Knowledge of mathematical thought and proof techniques
- Basic knowledge for further education
- Knowledge of applications of algebraical methods

**Grading through:**
- Exercises
- Test

**Responsible for this module:**
- Prof. Dr. Jan Modersitzki

**Teacher:**
- Institute of Mathematics and Image Computing
  - Prof. Dr. Jan Modersitzki

**Literature:**
- G. Strang: Lineare Algebra - Springer 2003
- K. Jänich: Lineare Algebra - Springer 2002
- D. Lau: Algebra und diskrete Mathematik I + II - Springer 2004

**Language:**
- Offered only in German
# Module Guide

## MA2500 - Analysis 2 (Ana2)

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<th>Turnus of offer:</th>
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<tbody>
<tr>
<td>Each summer semester</td>
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</table>

### Course of study, specific field and term:
- Bachelor Computer Science (compulsory), Mathematics, 2. Term
- Bachelor Medical Informatics (compulsory), Mathematics, 4. Term
- Bachelor MES (compulsory), Mathematics, 2. Term
- Bachelor Computer Science (compulsory), Mathematics, 4. Term
- Bachelor Medical Informatics SJ14 (compulsory), Mathematics, 2. Term

### Classes and lectures:
- Analysis 2 (Lecture, 2 SWS)
- Analysis 2 (Exercise, 1 SWS)

### Workload:
- 60 Hours Private studies
- 45 Hours Presence studies
- 15 Hours Test preparation

### Contents of teaching:
- indefinite and definite integrals
- fundamental theorem of calculus
- function series, power series
- trigonometric polynomials
- Fourier series, Fourier coefficients
- convergence of Fourier series

### Qualification-goals/Competencies:
- The students gain a deeper insight into some selected aspects of analysis.

### Grading through:
- Exercises
- Test

### Requires:
- Analysis 1 (MA2000)

### Responsible for this module:
- Prof. Dr. rer. nat. Jürgen Prestin

### Teacher:
- Institute for Mathematics
- Prof. Dr. rer. nat. Jürgen Prestin

### Literature:
- H. Heuser: Lehrbuch der Analysis 1+2
- K. Fritzsch: Grundkurs Analysis 1+2
- N. Henze: Stochastik für Einsteiger
- U. Krengel: Einführung in die Wahrscheinlichkeitstheorie und Statistik

### Language:
- Offered only in German

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<table>
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<th><strong>Module Guide</strong></th>
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**MA2502-MIW - Analysis 2 (Ana2)**

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<tbody>
<tr>
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### Course of study, specific field and term:
- Bachelor MES (Optional Subject), Mathematics, 4. Term
- Bachelor MES (Optional Subject), Mathematics, 2. Term

### Classes and lectures:
- Analysis 2 (Lecture, 2 SWS)
- Analysis 2 (Exercise, 1 SWS)

### Workload:
- 60 Hours Private studies
- 45 Hours Presence studies
- 15 Hours Test preparation

### Contents of teaching:
- Advanced multivariate differential calculus: implicit functions, Lagrange multipliers
- Bounded variation, curvilinear integrals of first and second kind
- Function series
- Linear operators in Hilbert spaces

### Qualification-goals/Competencies:
- Deeper insight into some selected aspects of analysis
- Deepening the basic knowledge and theory formation on a more abstract level

### Grading through:
- Exercises
- Test

### Responsible for this module:
- Prof. Dr. rer. nat. Jürgen Prestin

### Teacher:
- Institute for Mathematics
- Prof. Dr. rer. nat. Jürgen Prestin

### Literature:
- H. Heuser: Lehrbuch der Analysis 1+2
- K. Fritzsche: Grundkurs Analysis 1+2

### Language:
- Offered only in German
### ME1020 - Physics 2 (Physik2)

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<td>1 Semester</td>
<td>Each summer semester</td>
<td>8</td>
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</tbody>
</table>

#### Course of study, specific field and term:
- (compulsory), Physics, 2. Term
- Bachelor MES (compulsory), Physics, 2. Term

#### Classes and lectures:
- Physics II (Lecture, 4 SWS)
- Physics II Exercises (Exercise, 2 SWS)

#### Workload:
- 130 Hours Private studies
- 90 Hours Presence studies
- 20 Hours Test preparation

#### Contents of teaching:

#### Qualification-goals/Competencies:
- In-depth understanding of physical laws
- Quantitative description of experimental findings

#### Grading through:
- Test or Viva voce, made available by the lecturer

#### Requires:
- Physics 1 (ME1010)

#### Responsible for this module:
- Buzug, Prof. Dr. rer. nat. Thorsten
- Hübner, Prof. Dr. rer. nat Christian
- Vogel, Prof. Dr. rer. nat. Alfred

#### Teacher:
- Institute of Physics
- Institute of Medical Engineering
- Institute of Biomedical Optics
- Prof. Dr. rer. nat. Thorsten Buzug
- Prof. Dr. rer. nat. Christian Hübner
- Prof. Dr. rer. nat. Alfred Vogel

#### Literature:
- :

#### Language:
- Offered only in German
# Module Guide

## ME1550 - Einführung in die Medizintechnik (EinfMedtec)

<table>
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<td>Credit points:</td>
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### Course of study, specific field and term:
- Bachelor Medical Informatics (compulsory), medical computer science, 2. Term
- Bachelor MES (compulsory), Medical Engineering Sciences, 2. Term
- Bachelor Computer Science (compulsory), Enhanced course robotics and automation, 2. Term
- Bachelor Computer Science (compulsory), Enhanced course medical computer science, 2. Term

### Classes and lectures:
- Einführung in die Medizintechnik (Lecture, 2 SWS)
- Einführung in die Medizintechnik (Exercise, 1 SWS)

### Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

### Contents of teaching:
- Abriss zur historischen Entwicklung von Medizin und Medizintechnik
- Grundlagen der Anatomie und Physiologie
- Verfahren der Funktionsdiagnostik
- Bildgebende Systeme
- Therapiesysteme
- Monitoring
- Medizinische Informationsverarbeitung
- Wichtige gesetzliche Vorschriften
- Medizintechnische Anwendungen

### Qualification-goals/Competencies:
- Grundlagen der medizinischen Messtechnik
- Verständnis komplexer Zusammenhänge bei der Messtechnik physiologischer Parameter
- Kompetenz im Umgang mit Messunsicherheiten

### Grading through:
- Test or Viva voce, made available by the lecturer
- Exercises

### Responsible for this module:
- Prof. Dr. rer. nat. Thorsten Buzug

### Teacher:
- Institute of Medical Engineering
- MitarbeiterInnen des Instituts
- Prof. Dr. rer. nat. Thorsten Buzug

### Literature:
- :
- :
- :
- :
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### Language:
- Offered only in German
# MZ2100 D - Module Part: Course Physiology (Physio)

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## Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory), medical computer science, 2. Term
- (compulsory), Medicine, 2. Term
- Bachelor MES (compulsory), Medicine, 2. Term
- Bachelor Medical Informatics (compulsory), medical computer science, 2. Term

### Classes and lectures:
- Physiology (Lecture, 2 SWS)

### Workload:
- 45 Hours Private studies
- 30 Hours Presence studies
- 15 Hours Test preparation

## Contents of teaching:
- Skeletal Muscle, Motor Systems, Reflexes
- Sense Organs (Eye, Ear)
- Endocrinology
- Heart and Circulatory System, Respiration
- Blood and Immune System
- Water and Electrolyte Balance, Kidney

## Qualification-goals/Competencies:
- Basic knowledge about the functions of the most important organs and their interaction

## Grading through:
- Test

## Teacher:
- Institut of Physiology
- Prof. Dr. rer. nat. Horst Pagel
- Dr. rer. nat. Thomas Hellwig-Bürgel

## Literature:
- :

## Language:
- Offered only in German
# Module Guide

## MZ2100 E - Module Part: Course Cell Biology and Genetics (Zellbio)

<table>
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<th>Duration:</th>
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### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory), medical computer science, 4. Term
- Bachelor MES (compulsory), Medical Engineering Sciences, 2. Term
- Bachelor Medical Informatics (compulsory), medical computer science, 2. Term

### Classes and lectures:
- Cell Biology and Genetics (Lecture, 2 SWS)

### Workload:
- 60 Hours Private studies
- 30 Hours Presence studies

### Contents of teaching:
- Structure and functions of biological macromolecules
- Internal organization and functioning of cells
- Molecular genetics and gene regulation, epigenetics
- Flow of genetic information; genotype vs. phenotype
- Cell cycle
- Classical genetics
- Human genetics and inheritable diseases
- Ecological aspects of medicine (Interactions of humans, microbes, & environment)

### Qualification-goals/Competencies:
- Foundation knowledge in the BioSciences in subject areas with a strong relevance to Bioinformatics

### Grading through:
- Test

### Is requisite for:
- Molecular Genetics (LS3100)

### Teacher:
- Institute for Biology
  - Prof. Dr. rer. nat. Enno Hartmann
  - Prof. Dr. rer nat. Rainer Duden
  - PD Dr. rer. nat. Bärbel Kunze
  - Dr. rer. nat. Nicole Sommer

### Literature:
- Markl (Hrsg.): Biologie - Klett 2010 (ISBN: 978-3-12-150010-9)

### Language:
- Offered only in German
# MZ2500-MIW - Grundlagen der Medizin 2 (GMed2)

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**Course of study, specific field and term:**
- Bachelor MES (compulsory), Medical Engineering Science (expiring), 2. Term

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<td>MZ2500 B: Survey of Medical Professions 2 (Lecture, 1 SWS)</td>
<td>65 Hours Private studies</td>
</tr>
<tr>
<td>MZ2100 B: Pathologie (Lecture, 2 SWS)</td>
<td>40 Hours Test preparation</td>
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</table>

**Contents of teaching:**
- 

**Qualification-goals/Competencies:**
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- 
- 

**Grading through:**
- Test or Viva voce, made available by the lecturer

**Requires:**
- Grundlagen der Medizin 1 (MZ2100-MIW)

**Teacher:**
- Department of Pathology
- Institute of Anatomy
- Institut of Physiology
- Prof. Dr. rer. nat. Horst Pagel
- Prof. Dr. med. Jürgen Westermann
- Prof. Dr. med. Alfred C. Feller

**Literature:**
- :

**Language:**
- Offered only in German
## CS1000 - Programming (Prog)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
<th>Credit points:</th>
<th>8</th>
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<tbody>
<tr>
<td>Turnus of offer:</td>
<td>Each winter semester</td>
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<td></td>
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</tbody>
</table>

### Course of study, specific field and term:
- Bachelor Medical Informatics (compulsory: aptitude test), 1. Term
- Bachelor MES (compulsory), Computer Science Basics, 3. Term
- Bachelor MML (compulsory), Computer Science Basics, 1. Term
- Bachelor Computer Science (compulsory: aptitude test), 1. Term

### Classes and lectures:
- Programming (Lecture, 4 SWS)
- Programming (Exercise, 2 SWS)

### Workload:
- 125 Hours Private studies
- 90 Hours Presence studies
- 25 Hours Test preparation

### Contents of teaching:
- Definition: Algorithm
- Basic concepts of imperative and OO programming
- Basic data structures
- Abstract Data types

### Qualification-goals/Competencies:
- Understanding the nature of algorithms and their definition
- Basic knowledge about different programming paradigms (imperative, declarative, object-oriented, etc.)
- Profound knowledge about imperative and object-oriented programming
- Ability to define abstract data types
- In-depth knowledge of the Java programming language
- Ability to design, to implement, and to test simple programs
- Expertise to solve bigger programming tasks efficiently and timely using the acquired competences
- Learn to come up with solutions that satisfy accepted quality standards while operating with constrained resources in terms of time, man-power, etc.
- Ability to introduce new informatic or mathematical methods to products to be developed or existing solutions
- Basic understanding of product development in enterprises

### Grading through:
- Exercises
- Test

### Is requisite for:
- Algorithms and Data Structures (CS1001)

### Responsible for this module:
- Prof. Dr. Stefan Fischer

### Teacher:
- Institute of Telematics
- Prof. Dr. Stefan Fischer

### Literature:
- M. Broy: Informatik - eine grundlegende Einführung (Band 1 und 2) - Springer-Verlag 1998
- G. Goos und W. Zimmermann: Vorlesungen über Informatik (Band 1 und 2) - Springer-Verlag, 2006
- D. J. Barnes und M. Kölling: Objektorientierte Programmierung mit Java - Pearson Studium, 2003

### Language:
- Offered only in German
# CS1002 - Introduction to Logics (Logik)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>Each winter semester</td>
<td>4</td>
</tr>
</tbody>
</table>

## Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory), 3. Term
- Bachelor Computer Science (compulsory), Computer Science Basics, 3. Term
- Bachelor Medical Informatics (compulsory), 1. Term
- Bachelor MES (Optional Subject), 3. Term
- Bachelor MML (choice), 6. Term
- Bachelor Computer Science (compulsory), Computer Science Basics, 1. Term

## Classes and lectures:
- Logic (Lecture, 2 SWS)
- Logic (Exercise, 1 SWS)

## Workload:
- 65 Hours Self studies and exercises
- 45 Hours Presence studies
- 10 Hours Test preparation

## Contents of teaching:
- Key concepts of syntax: alphabet, string, term, formula
- Key concepts of semantics: assignment, structure, model
- Key concepts of proof calculus: axioms, proofs
- Formalization and coding of problems
- Validating correctness and satisfiability of formalizations
- Syntax and semantics of propositional logic
- Syntax and semantics of predicate logic
- Proof calculi

## Qualification-goals/Competencies:
- Acquire understanding of the concepts syntax and semantics through example logics
- Ability to apply formal systems and proof systems
- Ability to apply methods of mathematical logic to practical problems
- Ability to formalize discrete problems

## Grading through:
- Exercises
- Test

## Teacher:
- Institute for Theoretical Computer Science
- Prof. Dr. rer. nat. Till Tantau
- Prof. Dr. Rüdiger Reischuk

## Literature:
- Uwe Schöning: Logik für Informatiker - Spektrum Verlag, 1995
- Kreuzer, Kühlig: Logik für Informatiker - Pearson Studium, 2006
- Huth, Ryan: Logic in Computer Science - Cambridge University Press, 2004

## Language:
- Offered only in German
# CS1300 - Introduction to Medical Informatics (EMI)

| Duration: | 1 Semester |
| Turnus of offer: | Each winter semester |
| Credit points: | 4 |

## Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory: aptitude test), medical computer science, 1. Term
- Bachelor Medical Informatics (compulsory: aptitude test), medical computer science, 1. Term
- Bachelor MML (choice), 5. Term
- Bachelor MES (compulsory), Computer Science Basics, 3. Term
- Bachelor Computer Science (compulsory), Enhanced course medical computer science, 1. Term

## Classes and lectures:
- Introduction to Medical Informatics (Lecture, 2 SWS)
- Introduction to Medical Informatics (Exercise, 1 SWS)

## Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

## Contents of teaching:
- Basic concepts and methods of medical informatics
- Overview of the occupational field in medical informatics
- Introduction to the German healthcare system
- Introduction to eHealth: medical documentation, hospital information systems
- Medical imaging techniques
- Fundamentals of medical image computing
- Fundamentals of medical visualisation
- Health telematics
- Medical data security
- Fundamentals of knowledge based systems
- Introduction to bioinformatics
- Computer based evaluation of clinical and epidemiological studies

## Qualification-goals/Competencies:
- Overview of the methods in the art of medical informatics
- Knowledge of the institutional, organizational and legal framework in healthcare
- Knowledge of the essential concepts, methods and procedures in selected fields of medical informatics

## Grading through:
- Exercises
- Test

## Responsible for this module:
- Prof. Dr. rer. nat. habil. Heinz Handels

## Teacher:
- Institute of Medical Informatics
- Prof. Dr. rer. nat. habil. Heinz Handels
- PD Dr. rer. nat. habil. Josef Ingenerf

## Literature:
- P. Haas: Medizinische Informationssysteme und Elektronische Krankenakten - Berlin: Springer 2005

## Language:
- Offered only in German
<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>Each winter semester</td>
<td>8</td>
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</table>

**Course of study, specific field and term:**
- Bachelor MES (Optional Subject), Life Sciences, 3. Term

**Classes and lectures:**
- Basic Chemistry (Lecture with Exercises, 3 SWS)
- Basic Chemistry (practical course, 3 SWS)

**Workload:**
- 90 Hours group work
- 50 Hours Private studies
- 45 Hours Presence studies
- 35 Hours Exercises in groups
- 20 Hours Test preparation

**Contents of teaching:**

**Qualification-goals/Competencies:**
- 1. Understanding basic chemical concepts
- 2. Basics of anorganic chemistry

**Grading through:**
- Test

**Teacher:**
- Institute of Chemistry
- Institute of Medical Engineering
- Dr. Kerstin Lüdtke-Buzug
- PD Dr. phil. nat. Thomas Weimar

**Literature:**
- :
- :

**Language:**
- Offered only in German
### MA3110 - Numerics 1 (Num1)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
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<tbody>
<tr>
<td>Turnus of offer:</td>
<td>Each winter semester</td>
</tr>
<tr>
<td>Credit points:</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Course of study, specific field and term:
- (Optional Subject)
- Bachelor Computer Science (Optional Subject), Informatics central topics, 5. Term
- Master MES (Optional Subject), Mathematics, 1. Term
- Bachelor MES (Optional Subject), Mathematics, 3. Term
- Bachelor Computer Science (Optional Subject), Mathematics, 5. or 6. term
- Bachelor Medical Informatics SJ14 (Optional Subject), Mathematics, 5. or 6. term

#### Classes and lectures:
- Numerics 1 (Lecture, 2 SWS)
- Numerics 1 (Exercise, 1 SWS)

#### Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

#### Contents of teaching:
- Round-off errors and condition
- Direct solvers for linear equations
- LR decomposition
- Perturbation theory
- Cholesky decomposition
- QR decomposition, least squares fit

#### Qualification-goals/Competencies:
- Basic understanding of numeric tasks
- Mastering the modern programming language MATLAB
- Experience in the implementation of theoretical algorithms
- Ability to judge the quality of a method (accuracy, stability, complexity)

#### Grading through:
- Exercises
- Programming exercises
- Test

#### Requires:
- Linear Algebra and Discrete Structures 2 (MA1500)
- Linear Algebra and Discrete Structures 1 (MA1000)
- Analysis 2 (MA2500)
- Analysis 1 (MA2000)

#### Responsible for this module:
- Prof. Dr. Andreas Rößler

#### Teacher:
- Institute for Mathematics
- Prof. Dr. Andreas Rößler

#### Literature:
| Language: | Offered only in German |
| Notes: | The lecture is identical to that in module MA3110-MML/Numerics 1 |
## ME2000 - Ringvorlesung industrielle Medizintechnik (RingMedtec)

<table>
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<th>Duration:</th>
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</thead>
<tbody>
<tr>
<td>Turnus of offer:</td>
<td>Each winter semester</td>
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<tr>
<td>Credit points:</td>
<td>2</td>
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</table>

### Course of study, specific field and term:
- Bachelor MES (compulsory), Medical Engineering Sciences, 3. Term

### Classes and lectures:
- Ringvorlesung Geschichte der Medizintechnik (Lecture, 1 SWS)
- Ringvorlesung industrielle Medizintechnik (Lecture, 1 SWS)

### Workload:
- 20 Hours Written Presentation
- 20 Hours Private studies
- 20 Hours Presence studies

### Contents of teaching:

### Qualification-goals/Competencies:

### Grading through:
- Written elaboration
- Viva Voce or test

### Responsible for this module:
- Prof. Dr. rer. nat. Burghard Weiss

### Teacher:
- Institute for the History of Medicine and Science Studies
- Institute of Medical Engineering
- Prof. Dr. rer. nat. Thorsten Buzug
- Prof. Dr. med. Cornelius Borck
- Prof. Dr. rer. nat. Burghard Weiss

### Literature:
- :
- :

### Language:
- English, except in case of only German-speaking participants
## ME2040 - Theoretische Physik 1 (TheoPhys1)

| Duration: | 1 Semester | Turnus of offer: | Each winter semester | Credit points: | 4 | Max. group size: | 99 |

### Course of study, specific field and term:
- Bachelor MES (compulsory), Physics, 3. Term

### Classes and lectures:
- Theoretische Physik I (Lecture, 2 SWS)
- Theoretische Physik I (Exercise, 1 SWS)

### Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

### Contents of teaching:
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### Qualification-goals/Competencies:
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### Grading through:
- Test or Viva voce, made available by the lecturer

### Requires:
- Physics 1 (ME1010)
- Physics 2 (ME1020)

### Teacher:
- Institute of Medical Engineering
- Institute of Physics
- Prof. Dr. rer. nat. Christian Hübner
- Prof. Dr. rer. nat. Thorsten Buzug

### Literature:
- :

### Language:
- Offered only in German
# ME2053 - Physics Lab Course (PhysPrakt)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
<th>Turnus of offer:</th>
<th>Each winter semester</th>
<th>Credit points:</th>
<th>4</th>
</tr>
</thead>
</table>

### Course of study, specific field and term:
- Bachelor MLS (compulsory), Life Sciences, 3. Term
- Bachelor MES (compulsory), Physics, 3. Term
- (compulsory), Physics, 3. Term

### Classes and lectures:
- Physics Lab Course (practical course, 4 SWS)

### Workload:
- 55 Hours Written Presentation
- 45 Hours Presence studies
- 20 Hours Test preparation

### Contents of teaching:
- Experiment 1: fluid dynamics
- Experiment 2: heat
- Experiment 3: non stationary current
- Experiment 4: stationary current
- Experiment 5: spectrometer
- Experiment 6: diffusion
- Experiment 7: wave optics
- Experiment 8: geometrical optics
- Experiment 9: radio activity
- Experiment 10: sound and ultrasound

### Qualification-goals/Competencies:
- Hands-on access to physical relations
- Graphical representation of experimental data
- Excellence in interpreting data
- Excellence in documenting data and teamwork
- Basic knowledge in safety measures in the lab

### Grading through:
- Certificates and protocols

### Requires:
- Physics 2 (ME1020)
- Physics 1 (ME1010)
- Physics 2 (ME1020-MLS)
- Physics 1 (ME1010-MLS)

### Responsible for this module:
- Prof. Dr. rer. nat. Christian Hübner

### Teacher:
- Institute of Biomedical Optics
- Institute of Medical Engineering
- Institute of Physics
- Prof. Dr. rer. nat. Christian Hübner
- Prof. Dr. rer. nat. Thorsten Buzug
- PD Dr. rer. nat. Hauke Paulsen
- Prof. Dr. rer. nat. Alfred Vogel
- MitarbeiterInnen des Instituts

### Literature:
- Giancoli: Physik
Language:
  • Offered only in German
<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
<th>Turnus of offer:</th>
<th>Each winter semester</th>
<th>Credit points:</th>
<th>4</th>
</tr>
</thead>
</table>

**Course of study, specific field and term:**
- Bachelor MES (compulsory), Medical Engineering Sciences, 3. Term

**Classes and lectures:**
- Introduction into Biomedical Optics (Lecture, 2 SWS)
- Biomedical Optics/Exercises (practical course, 1 SWS)

**Workload:**
- 55 Hours Self studies and exercises
- 45 Hours Presence studies
- 20 Hours Test preparation

**Contents of teaching:**

**Qualification-goals/Competencies:**

**Grading through:**
- Test or Viva voce, made available by the lecturer

**Teacher:**
- Institute of Biomedical Optics
- Prof. Dr. rer. nat. Alfred Vogel
- PD Dr. rer. nat. Gereon Hüttmann

**Language:**
- Offered only in German
**ME2102 - Photonics (Photonik)**

<table>
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<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>Each winter semester</td>
<td>4</td>
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</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor MES (Optional Subject), Medical Engineering Sciences, 3. Term

**Classes and lectures:**
- Lecture Photonics (Lecture, 2 SWS)
- Exercises Photonics (Exercise, 1 SWS)

**Workload:**
- 45 Hours Presence studies
- 35 Hours Self studies and exercises
- 20 Hours Test preparation

**Contents of teaching:**

**Qualification-goals/Competencies:**

**Grading through:**
- Exercises
- Test or Viva voce, made available by the lecturer

**Teacher:**
- Institute of Biomedical Optics
- PD Dr. rer. nat. Gereon Hüttmann

**Language:**
- English, except in case of only German-speaking participants
# CS3110 - Computer-Aided Design of Digital Circuits (SchaltEntw)

| Duration: 1 Semester | Turnus of offer: Irregular | Credit points: 4 |

### Course of study, specific field and term:
- (Optional Subject), 5. or 6. term
- Bachelor Computer Science (Optional Subject), Informatics central topics, 5. or 6. term
- Bachelor MES (Optional Subject), Applied Computer Science, 3., 5. or 6. term
- Bachelor MML (choice), 5. or 6. term
- Bachelor Computer Science (Optional Subject), Informatics central topics, 5. or 6. term

### Classes and lectures:
- Computer-Aided Design of Digital Circuits (Lecture, 2 SWS)
- Computer-Aided Design of Digital Circuits (Exercise, 1 SWS)

### Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

### Contents of teaching:
- Abstraction levels in circuit design
- Design cycle and design strategies
- FPGA architectures
- Introduction of the hardware description language VHDL
- Design of standard components in VHDL
- Circuit design at different abstraction levels
- Circuit design for synthesis
- VHDL simulation cycle
- VHDL circuit design for FPGAs
- Designing Testbenches
- High-Level-Synthesis

### Qualification-goals/Competencies:
- Capability to design, model, simulate and test digital circuits
- Ability to use modern CAD-software
- Competence in VHDL design for synthesis

### Grading through:
- Exercises
- Viva Voce
- Test

### Requires:
- Fundamentals of Computer Engineering 2 (CS1202)

### Responsible for this module:
- Prof. Dr.-Ing. Thilo Pionteck

### Teacher:
- Institute of Computer Engineering
  - Prof. Dr.-Ing. Thilo Pionteck

### Literature:
- F. Kesel, R. Bartholomä: Entwurf von digitalen Schaltungen und Systemen mit HDLs und FPGAs - Oldenbour Verlag 2009

### Language:
Offered only in German
<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>Every third semester</td>
<td>4</td>
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</table>

**Course of study, specific field and term:**
- Master Computer Science (Optional Subject), advanced curriculum Algorithmics and Complexity Theory, 2. or 3. term
- Bachelor MES (Optional Subject), Medical Engineering Sciences, 3., 5. or 6. term
- Bachelor MML (choice), 6. Term

**Classes and lectures:**
- Module "Scientific Computing" (Lecture, 2 SWS)
- Module "Scientific Computing" (Exercise, 1 SWS)

**Workload:**
- 65 Hours Self studies and exercises
- 45 Hours Presence studies
- 10 Hours Test preparation

**Contents of teaching:**
- lineare und nichtlineare Gleichungssysteme, Eigenwertberechnungen
- High-Performance Computing (Parallesierungstechniken)
- Modellierungsaspekte

**Qualification-goals/Competencies:**
- Numerische Simulation von naturwissenschaftlichen Vorgängen
- Anwendung auf praxisrelevante Fragestellungen

**Grading through:**
- Exercises
- Test

**Teacher:**
- Institute for Theoretical Computer Science
- Institute of Mathematics and Image Computing
- Prof. Dr. Jan Modersitzki
- Prof. Dr. Rüdiger Reischuk

**Language:**
- Offered only in German
# CS1001 - Algorithms and Data Structures (AuD)

<table>
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<th>Credit points:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>Each summer semester</td>
<td>8</td>
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</table>

## Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (compulsory), 2. Term
- (Optional Subject)
- Bachelor Media Informatics SJ14 (compulsory), Computer Science Basics, 2. Term
- Bachelor Computer Science (compulsory: aptitude test), Computer Science Basics, 2. Term
- Bachelor Medical Informatics (compulsory), 2. Term
- Bachelor MES (compulsory), Computer Science Basics, 4. Term
- Bachelor MML (compulsory), Computer Science Basics, 2. Term
- Bachelor Computer Science (compulsory: aptitude test), Computer Science Basics, 2. Term

## Classes and lectures:
- Algorithms and Data Structures (Lecture, 4 SWS)
- Algorithms and Data Structures (Exercise, 2 SWS)

## Workload:
- 125 Hours Private studies
- 90 Hours Presence studies
- 25 Hours Test preparation

## Contents of teaching:

## Qualification-goals/Competencies:

## Grading through:
- Exercises
- Test

## Is requisite for:
- Databases (CS2700)
- Lab Course Software Engineering (CS2301)
- Software Engineering (CS2300SJ14)
- Theoretical Computer Science (CS2000)
- Algorithm Design (CS3000)

## Requires:
- Programming (CS1000)
- Introduction to Programming (CS1000SJ14)

## Responsible for this module:
- Nachfolger von Prof. Linnemann
- Prof. Dr. Volker Linnemann

## Teacher:
- Institute of Information Systems
- Prof. Dr. Volker Linnemann
- Nachfolger von Prof. Linnemann
<table>
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**LS2500 - Biology (Bio)**

<table>
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<tr>
<th>Duration:</th>
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<th>Credit points:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>Each summer semester</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor Computer Science (compulsory), Enhanced course Biology & IT, 2. Term
- Bachelor MES (Optional Subject), Medical Engineering Science (expiring), 4. Term
- Bachelor Computer Science (compulsory), Enhanced course Biology & IT, 4. Term

**Classes and lectures:**
- Biology for computer scientists (Lecture, 2 SWS)
- Biology for computer scientists (practical course, 1 SWS)

**Workload:**
- 75 Hours Private studies
- 45 Hours Presence studies

**Contents of teaching:**
- Structure and function of biological macromolecules
- Mitosis
- Classical genetics
- Viruses

**Qualification-goals/Competencies:**
- Teaching of basic knowledge in biology with special focus on areas important for bioinformatics

**Grading through:**
- Test

**Is requisite for:**
- Molecular Genetics (LS3100)

**Responsible for this module:**
- Prof. Dr. rer. nat. Enno Hartmann

**Teacher:**
- Institute for Biology
- Prof. Dr. rer. nat. Enno Hartmann
- PD Dr. rer. nat. Bärbel Kunze
- Prof. Dr. rer nat. Rainer Duden
- Dr. rer. nat. Nicole Sommer

**Literature:**
- Campbell & Reece: Biologie - Pearson
- Purves, Sadava, Orians, Heller: Biologie - Spektrum
- Markl - Klett

**Language:**
- Offered only in German
# MA2510 - Stochastics 1 (Stoch1)

<table>
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<th>Duration:</th>
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<tbody>
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<td>Each summer semester</td>
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<tr>
<td>Credit points:</td>
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</table>

## Course of study, specific field and term:
- (Optional Subject)
- Bachelor Computer Science (compulsory), Mathematics, 4. Term
- Bachelor Computer Science (compulsory), Mathematics, 4. Term
- Bachelor MES (compulsory), Mathematics, 4. Term
- Bachelor MML (compulsory), Mathematics, 2. Term
- Bachelor Medical Informatics SJ14 (Optional Subject), Mathematics, 5. or 6. term

## Classes and lectures:
- Stochastics 1 (Lecture, 2 SWS)
- Stochastic 1 (Exercise, 1 SWS)
- 65 Hours Self studies and exercises
- 45 Hours Presence studies
- 10 Hours Test preparation

## Contents of teaching:
- probability spaces
- basics of combinatorics
- conditional probability and stochastic independency
- random variables
- important discrete and continuous one-dimensional probability distributions
- characteristics of distributions
- law of large numbers, central limit theorem
- modeling examples from the life sciences

## Qualification-goals/Competencies:
- mastery of basic stochastic concepts
- elementary modeling competency

## Grading through:
- Exercises
- Test

## Is requisite for:
- Stochastic processes and modeling (MA4610)
- Modeling Biological Systems (MA4450-MML)
- Modeling Biological Systems (MA4450)
- Stochastics 2 (MA4020-MML)
- Stochastics 2 (MA4020)

## Requires:
- Analysis 1 (MA2000)

## Responsible for this module:
- Prof. Dr. Karsten Keller

## Teacher:
- Institute for Mathematics
- Prof. Dr. Karsten Keller

## Literature:
- N. Henze: Stochastik für Einsteiger - Vieweg
- U. Krengel: Einführung in die Wahrscheinlichkeitstheorie - Vieweg
Language:

- Offered only in German
## ME2050 - Theoretical Physics 2 (TheoPhys2)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>Each summer semester</td>
<td>4</td>
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</tbody>
</table>

### Course of study, specific field and term:
- Master MML (Optional Subject), Arbitrary semester
- Bachelor MES (compulsory), Physics, 4. Term

### Classes and lectures:
- Theoretical Physics 2 (Lecture, 2 SWS)
- Theoretical Physics 2 (Exercise, 1 SWS)

### Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

### Contents of teaching:
- Schrödinger equation
- Double slit experiment and wave-particle duality
- Expectation values and uncertainty relation
- Hilbert space and differential operators; momentum operator
- One-dimensional quantum systems
- Harmonic oscillator
- Ladder operators, operator algebras and commutator relations
- Connection between wave and matrix quantum mechanics
- Central forces and potential; torque

### Qualification-goals/Competencies:
- Understanding the basic concepts, foundations and mathematical structure of quantum mechanics
- In-depth recall of Fourier methods by their application in wave mechanics
- Acquisition of solution methods for differential equations
- Thorough acquaintance of handling operators, expectation values and commutator relations

### Grading through:
- Test or Viva voce, made available by the lecturer

### Requires:
- Analysis 2 (MA2500-MML)
- Analysis 2 (MA2500-MLS)
- Analysis 2 (MA2500)

### Responsible for this module:
- PD Dr. rer. nat. Jens Christian Claussen

### Teacher:
- Institute for Neuro- and Bioinformatics
- Institute of Medical Engineering
- Institute of Physics
- Prof. Dr. rer. nat. Christian Hübner
- Prof. Dr. rer. nat. Thorsten Buzug
- PD Dr. rer. nat. Jens Christian Claussen

### Literature:
- Thorsten Fließbach: Quantenmechanik - Spektrum Akademischer Verlag
- Gerald Gravert: Quantenmechanik - Aula Verlag
- H. Haken, H. C. Wolf: The Physics of Atoms and Quanta - Springer
- Richard P. Feynman, Leighton, Sands: The Feynman Lectures on Physics, Vol. 3 - Oldenbourg
- J. J. Sakurai, Jim Napolitano: Modern Quantum Mechanics - Pearson
Language:
- English, except in case of only German-speaking participants
# ME3500 - Projektpraktikum (PP)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>Each semester</td>
<td>4</td>
</tr>
</tbody>
</table>

**Course of study, specific field and term:**

- Bachelor MES (compulsory), Medical Engineering Sciences, 4. Term

**Classes and lectures:**

- Projektpraktikum (project work, 2 SWS)

**Workload:**

- 60 Hours group work
- 40 Hours Private studies
- 20 Hours Written Presentation

**Contents of teaching:**

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**Qualification-goals/Competencies:**

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**Grading through:**

- Written elaboration
- Regular and successful participation in the practical course, min. 80%
- Contributions to the discussion

**Teacher:**

- Institute of Medical Engineering
- Prof. Dr. rer. nat. Thorsten Buzug
- Alle prüfungsberechtigten DozentInnen des Studienganges

**Language:**

- Offered only in German
### CS1200 - Fundamentals of Computer Engineering (TGI)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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</thead>
<tbody>
<tr>
<td>2 Semester</td>
<td>Each summer semester</td>
<td>12</td>
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</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor MES (compulsory), Computer Science Basics, 4. und 5. Fachsemester
- Bachelor Computer Science (compulsory), Computer Science Basics, 2. and 3. term

**Classes and lectures:**
- Fundamentals of Computer Engineering (Lecture, 4 SWS)
- Fundamentals of Computer Engineering (Exercise, 2 SWS)
- Fundamentals of Computer Engineering (practical course, 3 SWS)

**Workload:**
- 200 Hours Private studies
- 135 Hours Presence studies
- 25 Hours Test preparation

**Contents of teaching:**
- Boolean algebra
- Switching functions
- Minimization
- Combinational logic
- Sequential logic
- Register-transfer languages
- Data processing units
- Control units
- Microprogramming
- Basic processor architectures
- Microcontrollers
- Assembler programming
- I/O-interfaces
- Interrupts
- Semiconductor components
- Circuit families
- Integrated circuits
- Programmable logic
- CAD-tools
- Memory technologies

**Qualification-goals/Competencies:**
- Students know the most important methods for the formal description of digital circuits like Boolean algebra or register-transfer languages
- They are well acquainted with the basic design methods for digital circuits on gate and register-transfer level
- They have knowledge about basic processor architectures and their programming in machine language
- They are able to program microcontrollers for simple applications in assembly language
- They know the basic technologies for the realization of digital circuits (bipolar, MOS, CMOS)
- They are able to design simple digital circuits making use of CAD-tools, to implement and test them in different technologies (TTL, FPGAs etc.)

**Grading through:**
- Exercises
- Regular and successful participation in practical course
- Test

**Teacher:**
- Institute of Computer Engineering
- Prof. Dr.-Ing. Erik Maehle

**Literature:**
- W. Schiffmann, R. Schmitz: Technische Informatik 1 - Grundlagen der digitalen Elektrotechnik - Berlin: Springer 2004
- W. Schiffmann, R. Schmitz: Technische Informatik 2 - Grundlagen der Computertechnik - Berlin: Springer 2005

Language:
- Offered only in German
## CS1500 - Introduction to Robotics and Automation (ERA)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>Each winter semester</td>
<td>4</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (Optional Subject), medical computer science, 5. or 6. term
- Bachelor Computer Science (compulsory), Enhanced course robotics and automation, 1. Term
- Bachelor MML (choice), 5. or 6. term
- Bachelor MES (Optional Subject), Medical Engineering Sciences, 5. Term
- Bachelor Computer Science (compulsory), Enhanced course robotics and automation, 1. Term

### Classes and lectures:
- Introduction to Robotics and Automation (Lecture, 2 SWS)
- Introduction to Robotics and Automation (Exercise, 1 SWS)

### Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

### Contents of teaching:
- Introduction
- Control systems
- Programmable Logic Controller (PLC)
- Combinatorial control
- Sequential control
- Feedback control systems
- Plants
- PID controller
- Controller parameterization
- Autonomous mobile robots
- AI-paradigma
- Elementary and emergent behaviors
- Sensors
- Actuators

### Qualification-goals/Competencies:
- Students have basic knowledge of control systems
- They are able to program simple application problems as PLC-program in the IEC-languages
- They understand the principal structure and functionality of autonomous wheel-driven robots
- They are able to program simple autonomous robots in a behavior-based way

### Grading through:
- Test or Viva voce, made available by the lecturer

### Teacher:
- Institute of Computer Engineering
- Prof. Dr.-Ing. Erik Maehle

### Literature:
- J. Knespl: Automatisierungstechnik 1 - Regelungstechnik - Köln: Stam-Verlag 1999

### Language:
- Offered only in German

### Notes:
- Computer Science students get a B certificate.
CS2000 - Theoretical Computer Science (TI)

Duration: 1 Semester
Turnus of offer: Each winter semester
Credit points: 8

Course of study, specific field and term:
- Bachelor MES (Optional Subject), 5. Term
- Bachelor Medical Informatics SJ14 (compulsory), 3. Term
- Bachelor Computer Science (compulsory), Computer Science Basics, 3. Term
- Bachelor Media Informatics SJ14 (compulsory), 3. Term
- Bachelor Medical Informatics (compulsory), 3. Term
- Bachelor Computer Science (compulsory), Computer Science Basics, 3. Term

Classes and lectures:
- Theoretical Computer Science (Lecture, 4 SWS)
- Theoretical Computer Science (Exercise, 2 SWS)

Workload:
- 135 Hours Self studies and exercises
- 90 Hours Presence studies
- 15 Hours Test preparation

Contents of teaching:
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Qualification-goals/Competencies:
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Grading through:
- Exercises and project tasks
- Viva Voce or test

Is requisite for:
- Algorithm Design (CS3000)
- Programming Languages (CS3052)
- Parallel Computing (CS3051)

Teacher:
- Institute for Theoretical Computer Science
  - Prof. Dr. Rüdiger Reischuk
  - Prof. Dr. rer. nat. Till Tantau
  - Prof. Dr. Maciej Liskiewicz

Literature:
- 
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- 

Language:
- Offered only in German
## CS2300-MIW - Software Engineering 1 (SWTechMIW)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>Each winter semester</td>
<td>4</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Bachelor MES (Optional Subject), 5. Term

### Classes and lectures:
- Software Engineering I (Lecture, 2 SWS)
- Software Engineering I (Exercise, 1 SWS)

### Workload:
- 60 Hours Self studies and exercises
- 45 Hours Presence studies
- 15 Hours Test preparation

### Contents of teaching:
- Overview on major fields of software engineering
- Software development, software process models
- Basic concepts of software systems
- System analysis and requirements engineering
- Software design and software architectures
- Implementation
- Testing and integration
- Installation, acceptance, maintainance

### Qualification-goals/Competencies:
- Understanding software design as an engineering process
- Knowledge of major software process models and description formalisms for software artefacts
- Ability to model software systems on different levels of abstraction
- Ability to systematically design software systems whose implementation meets the requirements
- Knowing the basic concepts of object-oriented modeling and design

### Grading through:
- Exercises
- Test or Viva voce, made available by the lecturer

### Requires:
- Algorithms and Data Structures (CS1001)
- Programming (CS1000)

### Teacher:
- Institute of Software Technology and Programming Languages
  - Prof. Dr. Martin Leucker

### Literature:
- :
- :
- :
- :
- :

### Language:
- Offered only in German
# CS3200 - Software Engineering II (SWEng)

| Duration: | 1 Semester |
| Turnus of offer: | Each winter semester |
| Credit points: | 4 |

## Course of study, specific field and term:
- Bachelor Medical Informatics (Optional Subject)
- Bachelor MML (Optional Subject), 5. or 6. term
- Bachelor MES (compulsory), Computer Science Basics, 5. Term
- Bachelor Computer Science (compulsory), Computer Science Basics, 5. Term

## Classes and lectures:
- Software Engineering II (Lecture, 2 SWS)
- Software Engineering II (Exercise, 1 SWS)

## Workload:
- 60 Hours Self studies and exercises
- 45 Hours Presence studies
- 15 Hours Test preparation

## Contents of teaching:
- Introduction to software engineering
- Software management
- Software quality assurance
- Software evolution
- Software reuse
- Re-engineering and phase-out
- Software productivity, expense, and estimation
- Legal aspects

## Qualification-goals/Competencies:
- Knowing the basic procedures of software engineering
- Quality awareness
- Knowing activities and factors of software management
- Ability to organize software projects and to evaluate software engineering processes
- Understanding software evolution

## Grading through:
- Exercises
- Test or Viva voce, made available by the lecturer

## Responsible for this module:
- PD Dr. Gerhard Buntrock

## Teacher:
- Institute of Software Technology and Programming Languages
- PD Dr. Gerhard Buntrock

## Literature:

## Language:
- Offered only in German
# Module Guide

## CS3310 - Modul part: Image and Signal Processing in Medicine 1 (MBS)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>1 Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turnus of offer:</td>
<td>Each winter semester</td>
</tr>
<tr>
<td>Credit points:</td>
<td>4</td>
</tr>
</tbody>
</table>

### Course of study, specific field and term:
- Bachelor MES (compulsory), Medical Engineering Sciences, 5. Term
- Bachelor Medical Informatics (compulsory), medical computer science, 5. Term

### Classes and lectures:
- Image and signal processing in medicine 1 (Lecture, 2 SWS)
- Image and signal processing in medicine 1 (Exercise, 1 SWS)

### Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

### Contents of teaching:
- Motivation, principles and applications of medical image and signal processing
- Signal processing in electrocardiography (ECG)
- Signal processing in the electroencephalogram (EEG)
- Structure and formats of medical images
- Fundamentals of pattern recognition (segmentation, feature extraction, classification, interpretation)
- Histograms and image transformations
- Image filtering with local operators
- Segmentation: thresholding, region growing
- Morphological operators
- Application and evaluation of segmentation methods
- Basic methods for the visualization of medical images and image sequences
- Basic methods of image registration: rigid image registration
- Combined signal and image analysis in functional MRI
- Application examples

### Qualification-goals/Competencies:
- Basic knowledge of methods and procedures of medical image processing
- Ability to evaluate and apply the application methods and algorithms in the respective phase of image processing pipelines
- Overview of the scope of medical image processing by many examples
- Capacity for communication and processing of medical image data
- Knowledge of methods for combined analysis of signal and image sequences in medicine

### Grading through:
- Exercises
- Test

### Is requisite for:
- Image and Signal Processing in Medicine 2 (CS3810)

### Teacher:
- Institute of Medical Informatics
- Prof. Dr. rer. nat. habil. Heinz Handels

### Literature:

### Language:
- Offered only in German
CS4340 - Health Economy (GOEK)

Duration: 1 Semester
Turnus of offer: Each winter semester
Credit points: 4

Course of study, specific field and term:
- Bachelor MES (compulsory), Medicine, 5. Term
- Master Computer Science (compulsory), Enhanced course medical computer science, 1. Term

Classes and lectures:
- Health Economy (Lecture, 2 SWS)
- Health Economy (Exercise, 1 SWS)

Workload:
- 55 Hours Self studies and exercises
- 45 Hours Presence studies
- 20 Hours Test preparation

Contents of teaching:
- Health care systems: comparison of international systems
- PART 1: NATIONAL ECONOMIC ASPECTS
  - Health Technology Assessment (HTA) as a tool for evidence-based decision support
  - Medical benefits analysis
  - Health economical evaluations
  - Allocation of resources and prioritization
- PART 2: BUSINESS ECONOMIC ASPECTS
  - Players in the health care system, social legislation and health care reforms
  - Hospital organization and accounting of health services
  - Compensation system in the outpatient and inpatient setting, especially G-DRG system
  - Internal and external accounting: cost and management accounting
  - DRG-based cost accounting and analysis tools
  - Innovation funding for medical devices and procedures

Qualification-goals/Competencies:
- Basic understanding of the responsibilities, functions and financing arrangements within health care systems
- PART 1: NATIONAL ECONOMIC ASPECTS
  - Knowledge of HTA as a tool to support health-related decisions
  - Basic knowledge of medical benefits analysis and of health economic evaluation studies
  - Knowledge of different models for resource allocation
- PART 2: BUSINESS ECONOMIC ASPECTS
  - Insight into the social legislation and hospital organization
  - Insight into the compensation system of outpatient and inpatient services, especially in the G-DRG system
  - Insight into the internal and external accounting, especially cost accounting
  - Ability to analyze the cost and performance accounting at the hospital, based on a DRG-based cost accounting
  - Knowledge of the funding of innovation within and outside of the GKV charge catalogs

Grading through:
- Participation in the exercises
- Test or Viva voce, made available by the lecturer

Responsible for this module:
- PD Dr. rer. nat. habil. Josef Ingenerf

Teacher:
- Institute for Social Medicine and Epidemiology
- Institute of Medical Informatics
- Prof. Dr. phil. Sascha Köpke
- Dipl.-Plegepäd. Katrin Balzer
- PD Dr. rer. nat. habil. Josef Ingenerf

Literature:
Module Guide


Language:

- Offered only in German
<table>
<thead>
<tr>
<th>Duration: 1 Semester</th>
<th>Turnus of offer: Each winter semester</th>
<th>Credit points: 4</th>
</tr>
</thead>
</table>

**Course of study, specific field and term:**
- Master Computer Science (Optional Subject), Enhanced course Biology & IT, 3. Term
- Bachelor MES (Optional Subject), Life Sciences, 5. Term

**Classes and lectures:**
- Biochemie 1 (Lecture, 3 SWS)

**Workload:**
- 55 Hours Presence studies
- 45 Hours Private studies
- 20 Hours Test preparation

**Contents of teaching:**
- Grundeigenschaften von Biosystemen, Biomoleküle
- Proteine: Struktur und Dynamik
- Enzyme: Struktur, Funktion, Regulation
- Intermediärstoffwechsel
- Biomembranen und Zellatmung

**Qualification-goals/Competencies:**
- Verständnis der Strukturen und Funktion grundlegender Biomoleküle
- Verständnis der biochemischen Zusammenhänge und ihrer Bedeutung für den zellulären Stoffwechsel zu verstehen
- Vermittlung der Prinzipien biochemischer Trenn- und Analyseverfahren

**Grading through:**
- Test

**Teacher:**
- Institute of Biochemistry
  - Prof. Dr. rer. nat. Rolf Hilgenfeld
  - Prof. Dr. rer. nat. Stefan Anemüller
  - Dr. math. et dis. nat. Jeroen Mesters

**Literature:**
- :  

**Language:**
- Offered only in English
## LS2200 - Introduction into Biophysics (EinBiophy)

<table>
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<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>Each winter semester</td>
<td>4</td>
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</tbody>
</table>

### Course of study, specific field and term:
- (Optional Subject)
- Bachelor MLS (compulsory), Life Sciences, 3. and 4. term
- Bachelor MML (choice), Life Sciences, 5. Term
- Bachelor MES (compulsory), Medical Engineering Sciences, 5. Term

### Classes and lectures:
- Biophysics (Lecture, 2 SWS)
- Lab course Biophysics (practical course, 1 SWS)

### Workload:
- 45 Hours Presence studies
- 40 Hours Private studies
- 15 Hours Written Presentation
- 10 Hours Test preparation

### Contents of teaching:
- Biological macro molecules, structure, forces
- Proteins, structure, properties
- Biomembranes, structure, properties
- Mechanical properties of cells
- Thermo dynamics of biological processes

### Qualification-goals/Competencies:
- Basic knowledge of physical aspects of living matter
- Excellence in the experimental investigation of life processes including quantitative treatment

### Grading through:
- Test or Viva voce, made available by the lecturer

### Responsible for this module:
- Prof. Dr. rer. nat. Christian Hübner

### Teacher:
- Institute of Physics
- Prof. Dr. rer. nat. Christian Hübner

### Literature:
- : Biophysik

### Language:
- Offered only in German
# MA3400 - Biomathematics (Biomathe)

<table>
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<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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</thead>
<tbody>
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<td>1 Semester</td>
<td>Each winter semester</td>
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</table>

## Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (Optional Subject), medical computer science, 5. or 6. term
- Bachelor Computer Science (compulsory), Enhanced course Biology & IT, 5. Term
- Master MES (Optional Subject), Mathematics, 1. Term
- Bachelor Medical Informatics (Optional Subject), Biology & IT
- Master Computer Science (Optional Subject), Enhanced course medical computer science, 3. Term
- Bachelor MES (Optional Subject), Mathematics, 5. Term
- Bachelor Computer Science (compulsory), Enhanced course Biology & IT, 5. Term

## Classes and lectures:
- Biomathematics (Lecture, 2 SWS)
- Biomathematics (Exercise, 1 SWS)

## Workload:
- 55 Hours Self studies and exercises
- 45 Hours Presence studies
- 20 Hours Test preparation

## Contents of teaching:
- Basics of differential equations
- Differential equations of first order
- Linear differential equations of n-th order
- Systems of linear differential equations with constant coefficients
- Notes on numerics and qualitative analysis; the prey-predator model

## Qualification-goals/Competencies:
- Learning the basics of ordinary differential equations
- Ability to apply differential equations
- Learning by means of examples how to use differential equations for models in biology, chemistry and medicine
- Basic understanding of simple numerical methods

## Grading through:
- Exercises
- Test

## Responsible for this module:
- Prof. Dr. rer. nat. Jürgen Prestin
- PD Dr. rer. nat. Hanns-Martin Teichert

## Teacher:
- Institute for Mathematics
- PD Dr. rer. nat. Hanns-Martin Teichert

## Literature:
- J. D. Murray: Mathematical Biology - Springer
- R. Schuster: Biomathematik - Vieweg + Teubner Studienbücher 2009

## Language:
- Offered only in German
# MA4020 - Stochastics 2 (Stoch2)

<table>
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<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>Each winter semester</td>
<td>4</td>
</tr>
</tbody>
</table>

## Course of study, specific field and term:
- Master MES (Optional Subject), Mathematics, 1. Term
- Master Computer Science (Optional Subject), Enhanced course Biology & IT, 3. Term
- Master Computer Science (compulsory), advanced curriculum Stochastics, 3. Term
- Master Computer Science (Optional Subject), advanced curriculum Analysis, 3. Term
- Bachelor MES (Optional Subject), Mathematics, 5. Term

## Classes and lectures:
- Stochastics 2 (Lecture, 2 SWS)
- Stochastics 2 (Exercise, 1 SWS)

## Workload:
- 65 Hours Self studies and exercises
- 45 Hours Presence studies
- 10 Hours Test preparation

## Contents of teaching:
- Lebesgue integral and Riemann integral
- Transformations of measures and integrals
- Product measures and Fubini's theorem
- Moments and dependency measures
- Normally distributed random vectors and distributions closely related to the normal distribution

## Qualification-goals/Competencies:
- Insight into basic aspects of measure and integration theory
- Mastery of techniques of integration being relevant to stochastics and of techniques for the treatment of (particularly normally distributed) random vectors and their distributions

## Grading through:
- Exercises
- Test or Viva voce, made available by the lecturer

## Is requisite for:
- Modeling Biological Systems (MA4450)
- Stochastic processes and modeling (MA4610)

## Requires:
- Stochastics 1 (MA2510)
- Linear Algebra and Discrete Structures 2 (MA1500)
- Analysis 2 (MA2500)

## Responsible for this module:
- Prof. Dr. Karsten Keller

## Teacher:
- Institute for Mathematics
- Prof. Dr. Karsten Keller

## Literature:
- J. Elstrodt: Maß- und Integrationstheorie - Springer
- M. Fisz: Wahrscheinlichkeitsrechnung und mathematische Statistik - Deutscher Verlag der Wissenschaften

## Language:
- Offered only in German

## Notes:
The lecture is identical to that in module MA4020-MML.
### ME3000 - Medical Imaging, Image and Signal Computing (MEDBGBV)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Semester</td>
<td>Each winter semester</td>
<td>8</td>
</tr>
</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor MES (compulsory), Medical Engineering Sciences, 5. Term
- Bachelor Medical Informatics (compulsory), medical computer science, 5. Term

**Classes and lectures:**
- Module part CS3310: Image and Signal Processing in Medicine 1 (Course, 3 SWS)
- Module part ME3100: Medical Imaging (Course, 3 SWS)

**Workload:**
- 110 Hours Private studies
- 90 Hours Presence studies
- 40 Hours Test preparation

**Contents of teaching:**
- See description of module parts

**Grading through:**
- Exercises
- Test

**Responsible for this module:**
- Prof. Dr. rer. nat. Thorsten Buzug

**Teacher:**
- Institute of Medical Engineering
- Institute of Medical Informatics
- Prof. Dr. rer. nat. habil. Heinz Handels
- Prof. Dr. rer. nat. Martin Koch

**Language:**
- German and English skills required
## ME3100 - Modul Part: Medical Imaging (MBG)

| Duration: | 1 Semester |
| Turnus of offer: | Each winter semester |
| Credit points: | 4 |

### Course of study, specific field and term:
- Bachelor MES (compulsory), Medical Engineering Sciences, 5. Term
- Bachelor Medical Informatics (compulsory), medical computer science, 5. Term

### Classes and lectures:
- Medical Imaging (Lecture, 2 SWS)
- Medical Imaging (practical course, 1 SWS)

### Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

### Contents of teaching:
- Introduction to the theory of imaging systems
- Conventional X-ray systems, Computed Tomography
- Magnetic Resonance Imaging
- Ultrasound imaging
- Positron Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT)

### Qualification-goals/Competencies:
- Knowing the principle of important medical imaging methods
- Knowing how imaging systems an their properties are described

### Grading through:
- Test

### Teacher:
- Institute of Medical Engineering
- Prof. Dr. rer. nat. Martin Koch

### Literature:
- H. Morneburg (Hrsg.): Bildgebende Systeme für die medizinische Diagnostik. 3. Aufl. - Publicis MCD Verlag, München 1995
- C. L. Epstein: Introduct ion to the mathematics of medical imaging - SIAM, Philadelphia 2008
- J. Jan: Medical Image Processing, reconstruct ion and restoration - Taylor and Francis, Boca Raton 2006
- W. Schlegel, J. Bille: Medizinische Physik, Bd. 2: Medizinische Strahlenphysik - Springer, Berlin 2002
- J. D. Bronzino (Hrsg.): The biomedical engineering handbook - CRC Press, Boca Raton 2000

### Language:
- German and English skills required
<table>
<thead>
<tr>
<th>Duration:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>Each winter semester</td>
<td>4</td>
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</tbody>
</table>

**Course of study, specific field and term:**
- Bachelor MES (compulsory), Medical Engineering Science (expiring), 5. Term

**Classes and lectures:**
- Image and signal processing in medicine (Lecture, 2 SWS)
- Image and signal processing in medicine (Exercise, 1 SWS)

**Workload:**
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

**Contents of teaching:**

**Qualification-goals/Competencies:**

**Grading through:**
- Exercises
- Test

**Teacher:**
- Institute of Medical Informatics
- Prof. Dr. rer. nat. habil. Heinz Handels

**Literature:**
- :
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- :

**Language:**
- Offered only in German

**Notes:**
- see new module CS3310
# ME3140 - Gesundheitsökonomie (GOek)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>Each winter semester</td>
<td>4</td>
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</tbody>
</table>

### Course of study, specific field and term:
- Bachelor MES (compulsory), Medical Engineering Science (expiring), 5. Term

### Classes and lectures:
- Health Economics (Lecture, 2 SWS)
- Health Economics (Exercise, 1 SWS)

### Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

### Contents of teaching:

### Grading through:
- Participation in the exercises
- Test or Viva voce, made available by the lecturer

### Teacher:
- Institute for Social Medicine and Epidemiology
- Institute of Medical Informatics
- PD Dr. rer. nat. habil. Josef Ingenerf
- Dr. med. Dagmar Lühmann

### Language:
- Offered only in German
# MZ3100 - Medical Quality Management (MedizQM)

<table>
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<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>Each winter semester</td>
<td>4</td>
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</tbody>
</table>

## Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (Optional Subject), medical computer science, 5. or 6. term
- (compulsory), Medicine, 3. Term
- Master Computer Science (Optional Subject), Enhanced course medical computer science, 3. Term
- Bachelor MES (compulsory), Medicine, 5. Term

## Classes and lectures:
- Medical Quality Management (Lecture, 2 SWS)
- Medical Quality Management (Exercise, 1 SWS)

## Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

## Contents of teaching:

## Qualification-goals/Competencies:

## Grading through:
- Test or Viva voce, made available by the lecturer

## Responsible for this module:
- Prof. Dr. med. Hartmut Gehring

## Teacher:
- Institute of Medical Engineering
- Prof. Dr. med. Hartmut Gehring

## Literature:
Language:
- Offered only in German
# CS2101 - Embedded Systems (ES)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>Each summer semester</td>
<td>4</td>
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</table>

## Course of study, specific field and term:
- Bachelor Medical Informatics SJ14 (Optional Subject), 5. or 6. term
- Bachelor Computer Science (Optional Subject), Informatics central topics, 6. Term
- Bachelor Computer Science (compulsory), Enhanced course robotics and automation, 4. Term
- Bachelor Medical Informatics (Optional Subject)
- Bachelor MES (compulsory), Computer Science of Systems, 6. Term

## Classes and lectures:
- Embedded Systems (Lecture, 2 SWS)
- Embedded Systems (Exercise, 1 SWS)

## Workload:
- 60 Hours Self studies and exercises
- 45 Hours Presence studies
- 15 Hours Test preparation

## Contents of teaching:
- Target architectures (microcontrollers, FPGAs etc.)
- Conceptional models
- Specification languages
- Transformation from specification to implementation
- Development tools
- Test methods

## Qualification-goals/Competencies:
- They know the most important target hardware architectures for embedded systems
- They are able to model embedded systems conceptionally and to specify them formally
- They are well acquainted with the model-based design, tool-based implementation and test of simple embedded systems

## Grading through:
- Exercises
- Test

## Requires:
- Fundamentals of Computer Engineering (CS1200)
- Fundamentals of Computer Engineering 1 (CS1200SJ14)

## Teacher:
- Institute of Computer Engineering
- Prof. Dr.-Ing. Erik Maehle

## Literature:
- :
- :
- :
- :

## Language:
- Offered only in German
# CS2150 - Computer Networks (CN)

| Duration: 1 Semester | Turnus of offer: Each summer semester | Credit points: 4 |

## Course of study, specific field and term:
- Bachelor Medical Informatics (compulsory), 4. Term
- Bachelor MES (Optional Subject), Applied Computer Science, 6. Term
- Bachelor Computer Science (compulsory), Computer Science Basics, 4. Term

## Classes and lectures:
- Computer Networks (Lecture, 2 SWS)
- Computer Networks (Exercise, 1 SWS)

## Workload:
- 65 Hours Private studies
- 45 Hours Presence studies
- 10 Hours Test preparation

## Contents of teaching:
- Computer Networks and the Internet
- Application Layer
- Transport Layer
- Network Layer
- Link and Physical Layer

## Qualification-goals/Competencies:
- At the end of the course, students know the most important concepts of computer networks
- Students know the importance of the different layers of the OSI and Internet protocol suite along with the most important protocols and services of each layer
- The students are able decide which network technologies to use to meet the requirements of any given application scenario
- The students know how the Internet works and are able to program small applications
- Students can apply the most important methods and algorithms from the field of networks

## Grading through:
- Exercises
- Test

## Responsible for this module:
- Prof. Dr. Stefan Fischer

## Teacher:
- Institute of Telematics
- Prof. Dr. Stefan Fischer

## Literature:
- Andrew S. Tanenbaum: Computernetzwerke - Pearson Studium, 2012

## Language:
- Offered only in German
## CS3204 - Artificial Intelligence 1 (KI1)

| Duration: | 1 Semester |
| Turnus of offer: | Each summer semester |
| Credit points: | 4 |

### Course of study, specific field and term:
- Bachelor Medical Informatics (Optional Subject), Applied Computer Science
- Bachelor MML (choice), 6. Term
- Bachelor MES (Optional Subject), Medical Engineering Sciences, 6. Term
- Bachelor Computer Science (compulsory), Enhanced course robotics and automation, 4. Term
- Bachelor Computer Science (Optional Subject), Informatics central topics, 5. or 6. term

### Classes and lectures:
- Artificial Intelligence (Lecture, 2 SWS)
- Artificial Intelligence (Exercise, 1 SWS)

### Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

### Contents of teaching:
- Foundations of artificial intelligence:
- Problem solving based on search: search trees, uninformed and informed search, local search & optimization, adversial search, heuristic search
- Machine learning: classification, regression, Bayes’ theorem, decision trees, neural networks
- Reasoning & knowledge engineering: prolog, fuzzy logic, probabilistic reasoning & casual networks
- Planning systems
- Knowledge engineering, logic
- Probabilistic reasoning
- Causal networks
- Geometric reasoning
- Kinematic algorithms
- Simulated Annealing

### Qualification-goals/Competencies:
- Knowledge of underlying techniques for discrete optimization and ability to apply them to new problems
- Profound knowledge of heuristic search
- Understanding of the functionality of games involving multiple players, i.e. chess
- Understanding of knowledge processing
- Knowledge of basic pattern recognition techniques with neural networks
- Ability to solve basic classification and regression problems using machine learning methods

### Grading through:
- Test

### Responsible for this module:
- Prof. Dr.-Ing. Achim Schweikard

### Teacher:
- Institute for Robotics and Cognitive Systems
  - Prof. Dr.-Ing. Achim Schweikard
  - MitarbeiterInnen des Instituts

### Literature:
- Russell/Norvig: Artificial Intelligence: a modern approach - Prentice Hall
- Mitchell: Machine Learning - Mcgraw-Hill
- Luger: Artificial Intelligence: Structures and Strategies for Complex Problem Solving - Alpha Books
<table>
<thead>
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<th>Language:</th>
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<td>• Offered only in German</td>
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</table>
Module Guide

CS4405 - Neuro-informatics (NeuroInf)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Credit points:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>4</td>
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</table>

Turnus of offer: Each summer semester

Course of study, specific field and term:
- Master MES (Optional Subject), Mathematics, 2. Term
- Bachelor MES (Optional Subject), 6. Term
- Master Computer Science (Optional Subject), advanced curriculum Organic Computing, 2. or 3. term
- Master MES (Consolidating), 2. Term
- Master Computer Science (Optional Subject), advanced curriculum Intelligent Embedded Systems, 2. or 3. term
- Master Computer Science (compulsory), Enhanced course robotics and automation, 2. Term
- Master Computer Science (compulsory), Enhanced course Biology & IT, 2. Term
- Master MML (compulsory), 2. Term

Classes and lectures:
- Neuro-informatics (Lecture, 2 SWS)
- Neuro-informatics (Exercise, 1 SWS)

Workload:
- 55 Hours Private studies
- 45 Hours Presence studies
- 20 Hours Test preparation

Contents of teaching:
- The human brain
- Neural networks
- Learning (in neural networks)
- Perceptrons
- Sparse coding
- Boltzmann machines
- Associative memories
- Self-organising maps
- Deep learning

Qualification-goals/Competencies:
- Principles of the human nervous system
- Insides into the information processing in the nervous system
- Derivation of learning rules
- Principles of the information processing and corresponding neural architectures
- Knowledge of principal neural network architectures
- Practical experience with common methods using supervised and unsupervised learning

Grading through:
- Exercises
- Test or Viva voce, made available by the lecturer

Teacher:
- Institute for Neuro- and Bioinformatics
- Prof. Dr. rer. nat. Thomas Martinetz

Literature:

Language:
- Offered only in German
## LS1600-MML - Organic Chemistry (OCMML)

<table>
<thead>
<tr>
<th>Duration:</th>
<th>Turnus of offer:</th>
<th>Credit points:</th>
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<tbody>
<tr>
<td>1 Semester</td>
<td>Each summer semester</td>
<td>4</td>
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</tbody>
</table>

### Course of study, specific field and term:
- Bachelor MES (Optional Subject), 6. Term
- Bachelor MML (compulsory), Life Sciences, 4. Term

### Classes and lectures:
- Organic Chemistry (Lecture, 3 SWS)

### Workload:
- 80 Hours Private studies
- 40 Hours Presence studies

### Contents of teaching:
- Introduction
- Alkanes, cycloalkanes
- Alkene and alkynes
- Aromatic compounds
- Stereoisomery
- Substitution and elimination reactions
- Alcohols, phenols and thiols
- Ether and epoxides
- Aldehydes and ketones
- Carboxylic acids and derivates
- Amines and derivates
- Heterocycles
- Lipids
- Carbohydrates
- Amino acids and peptides
- Nucleotides and nucleic acids

### Qualification-goals/Competencies:
- Understanding the principles of organic chemistry

### Grading through:
- Test

### Requires:
- Basic Chemistry (LS1100-MML)

### Responsible for this module:
- PD Dr. phil. nat. Thomas Weimar

### Teacher:
- Institute of Chemistry
- PD Dr. phil. nat. Thomas Weimar

### Literature:
- Buddrus, J.: Organische Chemie - De Gruyter Verlag

### Language:
- Offered only in German
MA1600 - Biostatistics 1 (BioStat1)

Duration: 1 Semester
Turnus of offer: Each summer semester
Credit points: 4

Course of study, specific field and term:
- Bachelor Computer Science (compulsory), Enhanced course Biology & IT, 6. Term
- Master MES (Consolidating), 2. Term
- Bachelor Medical Informatics (compulsory), medical computer science, 4. Term
- Master Computer Science (Optional Subject), Enhanced course Biology & IT, 2. or 3. term
- Master Computer Science (compulsory), advanced curriculum Stochastics, 2. Term
- Bachelor Computer Science (Optional Subject), Enhanced course Biology & IT, 6. Term
- Bachelor Computer Science (Optional Subject), Life Sciences, 6. Term
- Bachelor MES (Optional Subject), Medical Engineering Sciences, 6. Term
- Bachelor Computer Science (compulsory), enhanced course medical computer science, 6. Term
- Bachelor Medical Informatics SJ14 (compulsory), medical computer science, 4. Term

Classes and lectures:
- Biostatistics 1 (Lecture, 2 SWS)
- Biostatistics 1 (Exercise, 1 SWS)

Workload:
- 60 Hours Private studies
- 45 Hours Presence studies
- 15 Hours Test preparation

Contents of teaching:
- Descriptive statistics
- Probability theory, including random variables, density, and cumulative distribution function
- Normal distribution
- Diagnostic tests, reference range, normal range, coefficient of variation
- Statistical testing
- Sample size calculations
- Confidence intervals
- Selected statistical tests I
- Selected statistical tests II
- Analysis of variance (one-way-classification)
- Simple linear regression
- Clinical trials

Qualification-goals/Competencies:
- Knowledge of the most important methods of descriptive statistics
- Basic understanding of the approach to testing and estimation
- Practice in basic statistical test and estimation methods

Grading through:
- Test

Is requisite for:
- Biostatistics 2 (MA2600)

Responsible for this module:
- Prof. Dr. rer. nat. Andreas Ziegler

Teacher:
- Institute of Medical Biometry and Statistics
- Prof. Dr. rer. nat. Andreas Ziegler

Literature:

Language:
• Offered only in German
<table>
<thead>
<tr>
<th>Module Guide</th>
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<tbody>
<tr>
<td><strong>MA4030 - Optimization (Opti)</strong></td>
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</table>

**Duration:** 1 Semester  
**Turnus of offer:** Each summer semester  
**Credit points:** 8

**Course of study, specific field and term:**
- Master MES (Optional Subject), Mathematics, 2. Term
- Master Computer Science (Optional Subject), advanced curriculum Numerical Image Processing, 2. or 3. term
- Bachelor MES (Optional Subject), Medical Engineering Sciences, 6. Term
- Master Computer Science (Optional Subject), advanced curriculum Analysis, 2. or 3. term
- Bachelor MML (compulsory), Mathematics, 4. Term

**Classes and lectures:**
- Optimization (Lecture, 4 SWS)
- Optimization (Exercise, 2 SWS)

**Workload:**
- 130 Hours Self studies and exercises
- 90 Hours Presence studies
- 20 Hours Test preparation

**Contents of teaching:**
- Linear optimization
- Unconstrained and constrained nonlinear optimization
- Discrete optimization

**Qualification-goals/Competencies:**
- Fundamental knowledge and understanding of general optimization strategies
- Experience in realization of practical problems within the field of life sciences
- Experience in realization of theoretical concepts
- Competence and understanding of numerical results and simulations

**Grading through:**
- Exercises
- Test

**Requires:**
- Analysis 2 (MA2500)

**Responsible for this module:**
- Prof. Dr. Jan Modersitzki

**Teacher:**
- Institute of Mathematics and Image Computing
- Prof. Dr. Jan Modersitzki

**Literature:**
- J. Nocedal, S. Wright: Numerical Optimization - Springer

**Language:**
- Offered only in German
MA4040 - Numerics 2 (Num2)

Duration: 1 Semester
Turnus of offer: Each summer semester
Credit points: 4

Course of study, specific field and term:
- (Optional Subject)
- Master MES (Optional Subject), Mathematics, 2. Term
- Bachelor MES (Optional Subject), Medical Engineering Sciences, 6. Term
- Master Computer Science (Optional Subject), advanced curriculum Analysis, 2. or 3. term

Classes and lectures:
- Numerics 2 (Lecture, 2 SWS)
- Numerics 2 (Exercise, 1 SWS)

Contents of teaching:
- Polynomial interpolation
- Hermite interpolation
- Approximation
- Numerical quadrature

Workload:
- 60 Hours Self studies and exercises
- 45 Hours Presence studies
- 15 Hours Test preparation

Qualification-goals/Competencies:
- Becoming acquainted with fundamental numerical methods
- Understanding the transformation of a continuous problem into a discrete one
- Secure competencies in using both stable and robust numeric algorithms
- Experience in the implementation of practical tasks

Grading through:
- Exercises
- Programming exercises
- Test

Requires:
- Numerics 1 (MA3110)
- Linear Algebra and Discrete Structures 2 (MA1500)
- Linear Algebra and Discrete Structures 1 (MA1000)
- Analysis 2 (MA2500)
- Analysis 1 (MA2000)

Language:

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## Notes:

The lecture is identical to that in module MA4040-MML/Numerics 2
<table>
<thead>
<tr>
<th>ME2101 - Lasers in Medicine (Lasermed)</th>
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<tbody>
<tr>
<td>Duration:</td>
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<td>1 Semester</td>
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<th>Course of study, specific field and term:</th>
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<tbody>
<tr>
<td>(Optional Subject), Medical Engineering Sciences</td>
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<tr>
<td>Bachelor MES (Optional Subject), Medical Engineering Sciences, 6. Term</td>
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<table>
<thead>
<tr>
<th>Classes and lectures:</th>
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<tbody>
<tr>
<td>Interdisciplinary Lectures on Laser Medicine (Lecture, 2 SWS)</td>
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<tr>
<td>Interdisciplinary Lectures on Laser Medicine/Exercises &amp; Clinic Visits (Exercise, 1 SWS)</td>
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<th>Workload:</th>
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<tr>
<td>45 Hours Presence studies</td>
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<tr>
<td>35 Hours Self studies and exercises</td>
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<tr>
<td>20 Hours Test preparation</td>
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<tr>
<td>Test or Viva voce, made available by the lecturer</td>
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<table>
<thead>
<tr>
<th>Responsible for this module:</th>
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<tbody>
<tr>
<td>Prof. Dr. rer. nat. Alfred Vogel</td>
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<tr>
<th>Teacher:</th>
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<tbody>
<tr>
<td>Institute of Biomedical Optics</td>
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<tr>
<td>Prof. Dr. rer. nat. Alfred Vogel</td>
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### ME3702 - Bachelor Seminar MIW (SemMIW)

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<th>Duration:</th>
<th>1 Semester</th>
<th>Turnus of offer:</th>
<th>Each semester</th>
<th>Credit points:</th>
<th>4</th>
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</thead>
</table>

**Course of study, specific field and term:**
- Bachelor MES (compulsory), Interdisciplinary competence, 6. Term
- (compulsory), Medical Engineering Sciences, 4. und 5. Fachsemester

**Classes and lectures:**
- Bachelor Seminar (Seminar, 2 SWS)

**Workload:**
- 40 Hours Written Presentation
- 35 Hours Private studies
- 30 Hours Presence studies
- 15 Hours Presentation (including preparation)

**Contents of teaching:**
-  
-  
-  

**Qualification-goals/Competencies:**
-  
-  
-  

**Grading through:**
- Oral presentation and written report

**Teacher:**
- Clinics and institutes of the department of medicine
- Institutes of the department of natural science/computer science/engineering

**Language:**
- Offered only in English
### ME3990 - Bachelorarbeit Medizinische Ingenieurwissenschaft (BAMIW)

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<tr>
<td>1 Semester</td>
<td>Each semester</td>
<td>15</td>
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</tbody>
</table>

#### Course of study, specific field and term:
- Bachelor MES (compulsory), Medical Engineering Sciences, 6. Term

#### Classes and lectures:
- Bachelor Thesis (Private Study, 8 SWS)

#### Workload:
- 420 Hours Private studies

#### Contents of teaching:
- 

#### Qualification-goals/Competencies:
- 
- 
- 

#### Grading through:
- Recitation
- Written elaboration

#### Teacher:
- Medical technology companies at the Universität zu Lübeck or abroad with mandatory supervision by an university lecturer
- Scientific facilities at the Universität zu Lübeck or abroad with mandatory supervision by an university lecturer
- Institutes of the department of natural science/computer science/engineering
- Clinics and institutes of the department of medicine

#### Language:
- Thesis possible in German or English
### MZ3160 - Radiologie, Nuklearmedizin, Strahlentherapie (RNS)

**Duration:** 1 Semester  
**Turnus of offer:** Each summer semester  
**Credit points:** 3

**Course of study, specific field and term:**
- Bachelor Medical Informatics (compulsory), medical computer science, 6. Term
- Bachelor MES (compulsory), Medicine, 6. Term

**Classes and lectures:**
- Radiology, Nuclearmedicine, Radiotherapy (Lecture, 2 SWS)

**Workload:**
- 30 Hours Presence studies  
- 20 Hours Private studies  
- 20 Hours group work  
- 20 Hours Test preparation

**Contents of teaching:**

**Qualification-goals/Competencies:**

**Grading through:**
- Test

**Responsible for this module:**
- Prof. Dr. med. Jörg Barkhausen

**Teacher:**
- Prof. Dr. med. Jörg Barkhausen  
- PD Dr. Florian Vogt  
- PD Dr. Peter Hunold  
- Prof. Dr. Beate Stöckelhuber  
- Dr. Christian Mohr  
- Prof. Dr. med. Dirk Petersen  
- Dr. Lutz Schelper  
- Prof. Dr. med. Jürgen Dunst  
- Dr. rer. nat. Roger Nadrowitz  
- PD Dr. med. Dirk Rades  
- Dr. Corinna Melchert

**Literature:**
- "":  
- "":  
- "":  
- "":  

89
Language:
- Offered only in German
## PS1030 - English for Bachelor and Master students MLS (Engl)

### Duration:
- 2 Semester
- Each summer semester

### Turnus of offer:
- Each summer semester

### Credit points:
- 4

### Course of study, specific field and term:
- (Optional Subject), 2. Term
- (Optional Subject)
- Master MLS (choice), Interdisciplinary competence, Arbitrary semester
- Bachelor Computer Science (choice), Arbitrary semester
- Bachelor MES (choice), Medical Engineering Sciences, Arbitrary semester
- Master MML (choice), Interdisciplinary competence, Arbitrary semester
- Bachelor MLS (choice), Interdisciplinary competence, Arbitrary semester

### Classes and lectures:
- Workload:
  - 60 Hours Private studies
  - 60 Hours Presence studies

### Contents of teaching:
- Exercise: The content follows a curriculum, modified depending on the given skills and the thematic interests of the participants.
- Creating a CV in English

### Qualification-goals/Competencies:
- Acquisition of basic skills in spoken and written English
- Improvement of communication in English
- Improvement of reading and writing of texts in English, including technical literature

### Grading through:
- Exercises
- Regular and successful participation
- Test

### Responsible for this module:
- B. Sc. Sara Meitner, GradCertMol

### Teacher:
- University of Luebeck
- B. Sc. Sara Meitner, GradCertMol

### Literature:
- : - Publications and articles

### Language:
- Offered only in English

### Notes:
- no credits for Bachelor Informatik and Molecular Life Science
### PS5830 - Start-up and New Business (StartUp)

**Duration:** 1 Semester  
**Turnus of offer:** Irregular  
**Credit points:** 4 (Typ B)

#### Course of study, specific field and term:
- Master Medical Informatics SJ14 (Optional Subject), Interdisciplinary competence  
- (Optional Subject), Arbitrary semester  
- Master Computer Science (Optional Subject), Interdisciplinary competence, Arbitrary semester  
- Bachelor MES (Optional Subject), Interdisciplinary competence, Arbitrary semester  
- Bachelor Computer Science (Optional Subject), Informatics central topics, 5. or 6. term  
- Master MML (choice), Interdisciplinary competence, 2. or 3. term  
- Master Computer Science (Optional Subject), Interdisciplinary competence, 2. or 3. term

#### Classes and lectures:
- Start-up and New Business (Seminar, 1 SWS)  
- Start-up and New Business (practical course, 1 SWS)

#### Workload:
- 45 Hours Private studies  
- 30 Hours Written Presentation  
- 30 Hours Presence studies  
- 15 Hours Presentation (including preparation)

#### Contents of teaching:
- Entre-/ Intrapreneurship  
- Business Modelling  
- Technology product, value propositions, and customer benefit  
- Target groups, customer segments, and customer relations  
- Sales channels, marketing and sources of income  
- Key resources / activities / partners  
- costs and financing, including funding programs  
- special subjects: quality, acceptance for trading, legal form of organization, a.o.

#### Qualification-goals/Competencies:
- The students have gained basic insights in the field of Start-up, new product development and new business development.  
- They have acquired a sound knowledge of business modelling and planing.  
- They are able to develop a business plan based on a particular project.  
- They are able to assess the chances and risks of a start-up and new product / new business development.

#### Grading through:
- Recitation  
- Written elaboration  
- Regular and successful participation in the course  
- Successful handling of the project  
- Contributions to the discussion

#### Teacher:
- Institute of Software Technology and Programming Languages  
- Dr. Raimund Mildner

#### Literature:
- Aktuelle Forschungsartikel werden in der Veranstaltung bekanntgegeben.

#### Language:
- Offered only in German