Bachelor of Science (BSc) and Master of Science (MSc)

Medical Engineering

Increasing progress requires innovative development and improved procedures especially in the field of medical engineering. More than ever, enterprises in the field of medical technology need specialists with an engineering as well as medical background. A specific interdisciplinary education based on solid technical and scientific studies along with basic medical knowledge about physiological processes in the human body creates the qualification for further development of medical devices and materials.

Facts of Activity

- Further/new development of imaging techniques
- Development of highly complex devices for diagnostics and therapy
- Development and application of novel materials for implants and prosthesis
- Development of surgical robots and assisting systems

In addition to working in research, various job opportunities present themselves to graduates of healthcare engineering in locations like medical technology companies or hospitals. A specialization on topics like development, quality control, sales, and counseling or technical service and training for the handling of medical technical devices are further important assignment areas.

Subject Area and Study Program in Erlangen

By winning the BMBF leading-edge cluster in January 2010, the Medical Valley European EMN (Metropolitan Region Nuremberg) demonstrated once again to be the ideal location for globally acting corporate groups and medium-sized companies in the field of medical engineering. Collaborations with non-university research facilities like the Max-Planck-Institute or the Fraunhofer Society as well as globally leading industrial enterprises like Siemens Healthineers provide opportunities to students to gain valuable experience alongside their studies in an applied and industrial environment by hands-on training or workshops. Exchange programs with internationally leading universities in the field of medical engineering, e.g., the Johns Hopkins University and the Harvard Medical School in the US and the Peking University in China, complement the offered study program in Erlangen.
Bachelor Studies – Curriculum (all classes are taught in German!)

The two Bachelor programs “Imaging Techniques” and “Medical Devices and Prosthetics” are the ideal preparation for the Master’s program.

**Focus Imaging Techniques** (electrical engineering, information technology/computer science)

- **Semester 1:** Algorithms and data structures MT
- **Semester 2:** Analytical and physical knowledge for non-medical students I
- **Semester 3:** Analytical and physical knowledge for non-medical students II
- **Semester 4:** Algorithms of continuing systems
- **Semester 5:** Algorithms of continuing systems (5 ECTS from catalogue)
- **Semester 6:** Algorithms of continuing systems (5 ECTS from catalogue)

- **Medical engineering 1**
  - **Semester 1:** Experimental physics I
  - **Semester 2:** Experimental physics II

- **Mathematics for MT students 1**
  - **Semester 1:** Mathematics for MT students I
  - **Semester 2:** Mathematics for MT students II

- **Principles of electrical engineering I**
  - **Semester 1:** University practical course
  - **Semester 2:** Electronical fields I

- **Principles of electrical engineering II**
  - **Semester 1:** Statistics & strength of materials
  - **Semester 2:** Passive components*

- **Basics of electrical engineering I**
  - **Semester 1:** Information systems in healthcare
  - **Semester 2:** Signals and systems I*

- **Basics of electrical engineering II**
  - **Semester 1:** Information systems in healthcare
  - **Semester 2:** Signals and systems II*

- **Bachelor thesis**
  - **Semester 1:** Imaging techniques for example:
  - **Semester 2:** Imaging techniques for example:
  - **Semester 3:** Medical imaging methods for radiology
  - **Semester 4:** Medical imaging methods for radiology
  - **Semester 5:** Free choice university/key skills
  - **Semester 6:** Free choice university/key skills

**All classes are taught in German!**

**Focus Medical Devices and Prosthetics** (mechanical engineering/materials sciences/chemical & bioengineering)

- **Semester 1:** Algorithms and data structures MT
- **Semester 2:** Analytical and physical knowledge for non-medical students I
- **Semester 3:** Analytical and physical knowledge for non-medical students II
- **Semester 4:** Algorithms of continuing systems
- **Semester 5:** Algorithms of continuing systems (5 ECTS from catalogue)
- **Semester 6:** Algorithms of continuing systems (5 ECTS from catalogue)

- **Medical engineering 1**
  - **Semester 1:** Experimental physics I
  - **Semester 2:** Experimental physics II

- **Mathematics for MT students 1**
  - **Semester 1:** Mathematics for MT students I
  - **Semester 2:** Mathematics for MT students II

- **Principles of electrical engineering I**
  - **Semester 1:** University practical course
  - **Semester 2:** Electronical fields I

- **Principles of electrical engineering II**
  - **Semester 1:** Statistics & strength of materials
  - **Semester 2:** Passive components*

- **Basics of electrical engineering I**
  - **Semester 1:** Information systems in healthcare
  - **Semester 2:** Signals and systems I*

- **Basics of electrical engineering II**
  - **Semester 1:** Information systems in healthcare
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- **Bachelor thesis**
  - **Semester 1:** Imaging techniques for example:
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  - **Semester 6:** Free choice university/key skills

**Ratio of subjects in Bachelor studies**

In the first two semesters a basic education – independent of further specification – takes place. For subject-specific profile formation specialization on one of the following fields of competence takes place in the Bachelor phase starting in the third semester:

- **Imaging techniques** (electrical engineering, information technology/computer science)
- **Medical devices and prosthetics** (mechanical engineering/materials sciences/chemical & bioengineering)

**Perspectives**

**Bachelor**

The bachelor degree in medical engineering, with scientific and practical approach, teaches broad, fundamental engineering knowledge combined with interdisciplinary, medical and technical experience in 6 semesters. The basic principles of medical processes, anatomical and physiological context as well as treatment forms in a clinical environment are part of the program.

**Master**

The master course of studies in medical engineering with a regular study period of 4 semesters, in a technical and research-oriented course of studies with a focus on medical solutions. It is to convey systemic and instrumental competencies – besides expert and methodological knowledge – continuous interdisciplinary competencies in the occupational field of medical engineering. A complete English taught branch of the master’s program is offered called “Medical Image and Data Processing” with a strong focus on programming and computer science.

**Masters**

The master’s program Medical Engineering (4 semesters) can be started after successfully completing a subject-related bachelor program. It offers interesting branches of specialization and the formation of one’s own profile. Only one branch is taught in English!

- **Medical Electronics**
  - In the medical electronics program, in-depth skills regarding hardware and software systems of medical devices are acquired. Fundamental knowledge of the engineering sciences in the field of electrical engineering, electronics, and information technology are the basis for this branch

- **Medical Imaging and Data Processing**
  - This branch is the only taught 100% in English! Deepened expertise and methodological competence about software systems in medical engineering are to be acquired. They range from basic algorithms for image enhancement, image reconstruction, image registration, and computer-based diagnosis to medical information systems.

- **Medical Devices, Manufacturing Engineering, and Prosthetics**
  - In this branch of study, the graduates gain in-depth expertise and methodological competence for construction and manufacturing of high-class medical-technical devices and implants in consideration of the interdisciplinarity with the special biological surroundings at or within the human body.

Besides obligatory and optional modules, the master’s program is made up of courses for personal competence build-up and of the master thesis. Additionally, an research internship is integrated in the curriculum, which deepens scientific work. Depending on the choice of studies – either Medical Imaging & Data Processing, Medical Electronics, or Medical Devices & Manufacturing – one may decide on several proposals of the particular obligatory modules of the respective course. Eventually, the following are the key skills to continue your research oriented career with a doctorate’s program.

**What about the career prospects?**

The global market for medical devices is valued at approximately 200 Billion Euros at present. The growth of the market is predicted to be approx. 11%, which correlates to the average growth of sales in the past 5 years. The strong position results from the fact that approx. 10 % of all medical engineer’s patents originate from Germany (number 2) and that approximately 170,000 employees are engaged in the medical engineering sector in Germany. Especially trained employees for medical engineering are still sought-after.