

Appendices master's degree programme Biomedical Engineering

2014-2015

Appendix I. Learning outcomes of the degree programme (art. 1.3)

Learning outcomes after year 1

Students have knowledge of:

1. Anatomy of the musculoskeletal, circulatory, digestive, respiratory, excretory, endocrine and nervous systems and general knowledge of tissues;
2. Physiology of the muscular, circulatory, digestive, respiratory, sensory, nervous system;
3. General (patho)physiologic mechanisms (inflammation, infection, immunology, repair);
4. Principles of biochemistry and cell biology;
5. Bio-instrumentation; overview of diagnostic instruments, their possibilities, limitations, physical principles, phenomena they measure, the relation with the required information;
6. Medical imaging in terms of an overview of present equipment for diagnostics, their possibilities and limitations, their physical principles, the phenomena they measure;
7. Biochemistry in terms of cell compartments; biological macromolecules; enzyme mechanisms; structure and function of membranes, antibodies, carbohydrates, lipids, proteins;
8. Biomaterials in terms of an overview of potential materials, their properties, applications and limitations in terms of biocompatibility and failure mechanisms and current research into biomaterials;
9. Signal analysis, system dynamics and computational mathematics and current research into signal analysis;
10. Biomechanics in terms of statics, mechanics of materials (strength, stiffness, stress, deformation), dynamics (kinematics, kinetics, including gait analysis) and current research into biomechanics;
11. Biotransport in terms of heat transport, mass transport, biofluid mechanics;
12. Design/development; methodology, risk analysis, project management, market survey.
13. Ethics, including regulatory affairs and social implications;
14. Functioning of practical training in a European industry or hospital setting;

Student skills: students are able to:

1. Apply knowledge and understanding in performing research to realise new techniques for diagnosis and therapy;
2. Apply knowledge and understanding in designing new/improved diagnostic instruments and therapy devices;
3. Make judgements, integrating medical, cultural, social, ethical insights into her/his work;
4. Communicate about biomedical engineering in English in the written and spoken word;
5. Co-operate with other biomedical engineers and with medical experts;
6. Co-operate with international colleagues;
7. Reason soundly and to critically reflect on their own and others work;

Learning outcomes after year 2

For the specialisation 'Prostheses & Implant Interface Technology'

Students must have knowledge of:

1. Concepts of prostheses, implants and tissue engineering and its application;
2. Biological failure mechanisms of prostheses and implants;
3. Materials to be used for prostheses, implants and tissue engineering;

Students must have insight into:

1. Numerical simulation methods for the functioning of prostheses and implants;
2. Measuring methods for the physical functioning of prostheses and implants;
3. Evaluation methods for the biological functioning of prostheses and implants;
4. Methods for realizing function restoration;
5. Methods regarding tissue engineering (such as related to stem cell and gene therapy);

Students must be able to apply:

1. Methods to determine biomechanical properties of biological tissues;
2. Cell biology evaluations;

Students must be able to integrate:

1. Acquired knowledge of concepts and methods for realizing function restoration;
2. Acquired knowledge of concepts and methods for performing research on new technologies to improve therapy.

For the specialisation 'Clinical Physics'

Students must have knowledge of:

1. Concepts of control engineering;

Students must have insight into:

1. Methods for determining the performance of measuring and control equipment;
2. Methods for performing non-invasive anatomical and functional measurements;

Students must be able to apply:

1. Signal analysis methods;

Students must be able to integrate:

1. Acquired knowledge of facts and concepts and acquired methods for realizing improvements in Medical Instrumentation and Imaging;
2. Acquired knowledge of concepts and methods for performing research on new technologies to improve diagnosis.

**Appendix II. Specialisations of the degree programme
(art. 2.2)**

The degree programme is divided into the following specialisations:

- a. Clinical Physics
- b. Prostheses & Implant Interface Technology

Appendix III. Content of degree programme (art. 2.3)

1. Course elements year 1

1.a. General course elements

Master's Curriculum	ECTS	Assessment	Practical
Biomaterials 2	5	W	no
Control Engineering	5	WR	no
Modelling and Simulation	5	R	yes
Technology and the Ethics of Research	5	E	no
Radiation Physics	5	W	no
Mechatronics	5	W	no
Interdisciplinary Project	5	RP	yes
Biomedical Instrumentation 2	5	R	no
Optional modules	5		
Internship	15	RP	yes
Colloquia (7) *	-	R	no

* As described in the Guidelines on Nestor

1.b. CEMACUBE course elements

Master's Curriculum	ECTS	Assessment	Practical
Optional modules	10		
Basic Biomedical Knowledge 1	5	WRP	yes
Numerical Methods	5	WR	no
Materiaalkunde	5	WR	yes
Technology and the Ethics of Research	5	E	no
Basic Biomedical Knowledge 2	5	WRP	yes
Interdisciplinary Project	5	RP	yes
Biomedical Instrumentation 2	5	R	no
Internship	15	RP	yes

2. Course elements year 2

2.a. Course elements of the specialisation *Clinical Physics*

Master's Curriculum	ECTS	Assessment	Practical
Optional Modules	5		
Physics in Nuclear Medicine	5	W	no
Imaging Techniques in Radiology 2	5	WRP	yes

Magnetic Resonance Physics	5	W	no
Medical Physics in Radiation Oncology	5	WR	no
Master's Project *	35	RP	yes

* As described in the Guidelines on Nestor

2.b. Course elements of the specialisation *Prostheses & Implant Interface*

Technology

Master's Curriculum	ECTS	Assessment	Practical
Optional Modules	20		
Surface Characterization	5	WRP	yes
Master's Project *	35	RP	yes

* As described in the Guidelines on Nestor

Mode of examination:

(W) Written or Oral Examination

(R) Practical or Report

(P) Presentation

(E) Essay

**Appendix IV. Optional modules
(art. 2.4)**

1. Optional course elements year 1

Master's Curriculum	ECTS	Assessment	Practical
Engineering & Biotribology	5	WP	no
Modelling of Dynamical Systems	5	WR	yes
Statistical Methods in Physics	5	WR	no

2. Optional course elements year 2

2.a. Specialization Clinical Physics

Master's Curriculum	ECTS	Assessment	Practical
Image Processing	5	WR	no
Scientific visualization	5	R	no

2.b. Specialization Prostheses & Implant Interface Technology

Implants Interface Technology related courses

Master's Curriculum	ECTS	Assessment	Practical
Interface Biology	5	WRP	yes
Colloid and Interface Science	5	W	no
Recent Development in Biomaterials	5	RP	yes
Integrated Lab Course in Biomaterials	5	RP	yes

Prostheses related courses

Master's Curriculum	ECTS	Assessment	Practical
Prosthetics and Orthotics	5	WP	no
Product Design by the Finite Element Method	5	W	no
Neuromechanics	5	W	no
Robotics	5	WRP	yes

Mode of examination:

- (W) Written or Oral Examination
- (R) Practical or Report
- (P) Presentation
- (E) Essay

e. Courses selected by students.

Upon request of the student, the Board of Examiners can give permission to follow a course that is not mentioned above.

The request procedure must be started at least 4 weeks before the beginning of the course. The procedure is started as soon as the Board of Examiners receives a new programme proposal in which the permission is requested. In this programme proposal, the student must state the relevance of the selected course for their individual curriculum.

The Board of Examiners will decide on an individual basis if permission is granted. The student will be informed in writing about the decision on their permission within 6 weeks.

Appendix VI. Admission to the degree programme and different specializations (art. 4.1.1 + art. 4.2)

Admission to the Master's degree programme

1. Holders of a Bachelor's degree in Life Science & Technology with a major Biomedical Engineering from the University of Groningen are considered to have sufficient knowledge and skills and will be directly admitted to the Master's degree programme.
2. Students with Bachelor's degrees in Physics, Physical Engineering, Chemistry, Chemical Engineering, Mechanical Engineering or Electrical Engineering are admitted under the condition that they follow the course elements Basic Biomedical Knowledge 1 and 2 to catch up on the necessary biological background knowledge.
3. CEMACUBE students follow different course elements in year 1 to catch up on the necessary biological background knowledge. In year 2 CEMACUBE students follow the regular specialization programme.
4. All other students (this includes students from other universities or from universities of applied sciences) who apply for the Master's degree programme are screened by the BME Admissions Board, which suggests a pre-Masters bridging programme based on the candidates previous education. The pre-Master programme will be set-up by the study advisor and will have a fixed amount of ECTS (15, 30, 45 or 60 ECTS).
5. International students (these are students with a non-Dutch Bachelor degree) need to submit their application via the online application system of the University of Groningen to the Admissions Office. The admission deadlines are presented in Appendix IV. All international candidates are screened by the BME Admissions Board, which suggests a Master's programme based on the candidates previous education.