Appendices master's degree programme
Biomedical Engineering
2012-2013

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

Learning outcomes after year 1

Students have basic knowledge of:

- Anatomy of the musculoskeletal, circulatory, digestive, respiratory, excretory, endocrine and nervous systems and general knowledge of tissues;
- Physiology of the muscular, circulatory, digestive, respiratory, sensory, nervous system;
- General (patho)physiologic mechanisms (inflammation, infection, immunology, repair);
- Principles of biochemistry and cell biology;
- Bio-instrumentation; overview of diagnostic instruments, their possibilities, limitations, physical principles, phenomena they measure, the relation with the required information;
- Medical imaging in terms of an overview of present equipment for diagnostics, their possibilities and limitations, their physical principles, the phenomena they measure;
- Biochemistry in terms of cell compartments; biological macromolecules; enzyme mechanisms; structure and function of membranes, antibodies, carbohydrates, lipids, proteins;

Students have advanced knowledge of:

- 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;
- Signal analysis, system dynamics and computational mathematics and current research into signal analysis;
- Biomechanics in terms of statics, mechanics of materials (strength, stiffness, stress, deformation), dynamics (kinematics, kinetics, including gait analysis) and current research into biomechanics;
- Biotransport in terms of heat transport, mass transport, biofluid mechanics;
- Design/development; methodology, risk analysis, project management, market survey.
- Ethics, including regulatory affairs and social implications;
- Practical training in a European industry or hospital;

Student skills: students are able to:

- apply knowledge and understanding in performing research to realise new techniques for diagnosis and therapy;
- apply knowledge and understanding in designing new/improved diagnostic instruments and therapy devices;
- make judgements, integrating medical, cultural, social, ethical insights into her/his work;
- communicate in English having very good command of written and spoken language;
- co-operate with other biomedical engineers and with medical experts;
- co-operate with international colleagues;
- reason soundly and to critically reflect on their own and others work;

Learning outcomes after year 2

a. for the specialisation 'Prostheses & Implant Interface Technology'

Students must have knowledge of:

- concepts of prostheses, implants and tissue engineering and its application;
- biological failure mechanisms of prostheses and implants;
- materials to be used for prostheses, implants and tissue engineering;

Students must have insight into:

- numerical simulation methods for the functioning of prostheses and implants;
- measuring methods for the physical functioning of prostheses and implants;
- evaluation methods for the biological functioning of prostheses and implants;
- methods for realizing function restoration;
- methods regarding tissue engineering (such as related to stem cell and gene therapy);

Students must be able to apply:

- methods to determine biomechanical properties of biological tissues;
- cell biology evaluations;

Students must be able to integrate:

- acquired knowledge of concepts and methods for realizing function restoration;
- acquired knowledge of concepts and methods for performing research on new technologies to improve therapy.

b. for the specialisation Clinical Physics

Students must have knowledge of:

- concepts of control engineering;

Students must have insight into:

- methods for determining the physical functioning of measuring and control equipment;
- methods for performing non-invasive anatomical and functional measurements;

Students must be able to apply:

- signal analysis methods;

Students must be able to integrate:

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

Appendix B Specializations of the degree programme (art. 2.2)

	The degree programme is divided into the following specializations:
a)	specialization: Prostheses & Implant Interface Technology
b)	specialization: Clinical Physics

Appendix C Content of degree programme (art. 2.3)

a. General course elements

Course elements	ECTS	Assessment	Practical
Biomaterials 2	5	W	no
Technology and Ethics	5	E	no
Interdisciplinary Project	5	RP	yes
Numerical Methods	5	WR	no
Internship	15	RP	yes
Master's Project	35	RP	yes

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

Master's Curriculum	ECTS	Assessment	Practical
Optional Modules	20		
Recent Developments in Biomaterials	5	RP	yes
Interface Biology	5	WRP	yes

c. Course elements of the specialisation *Clinical Physics*

Master's Curriculum	ECTS	Assessment	Practical
Optional Modules	20		
Electronics and Signal Processing	5	WRP	yes
Radiation Physics	5	W	no
Principles of Measurement Systems	5	W	no

d. CEMACUBE (1st year)

Master's Curriculum	ECTS	Assessment	Practical
Basic Biomedical Knowledge I	5	WRP	yes
Basic Biomedical Knowledge II	5	WRP	yes
Imaging Techniques in Radiology	5	WRP	yes
Biomedical Instrumentation	5	WR	no
Material Science	5	W	no
Technology and Ethics	5	E	no
Interdisciplinary Project	5	RP	yes
Neuromechanics	5	W	no
Internship	15	RP	yes

Mode of examination:
(W) Written or Oral Examination
(R) Practical or Report
(P) Presentation
(E) Essay

Appendix D Optional modules (art. 2.4)

a. Prostheses & Implant Interface Technology

Master's Curriculum	ECTS	Assessment	Practical
Control Engineering	5	WR	no
Reasoning and Arguing	5	W	no
Physics of Transport Phenomena 2	5	W	no
Product Design & Finite Element Method	5	R	no
Solid Mechanics	5	WR	no
Mechatronics	5	W	no
Philosophy of Exact Sciences	5	W	no
Surface Characterization	5	WRP	yes
Robotics	5	W	no
Molecular Biophysics	5	W	no
Transport in Biological Systems	5	W	no
Tools and Approaches in Systems Biology	5	WRP	yes
Innovative Dosage Forms	5	RP	yes
Integrated Lab Course Biomaterials	5	RP	yes
Neuromechanics	5	W	no
Colloid and Interface Science	5	W	no

b. Clinical Physics

Master's Curriculum	ECTS	Assessment	Practical
Radiation Safety	3	WR	no
Magnetic Resonance Physics	5	W	no
Mechatronics	5	W	no
Philosophy of Exact Sciences	5	W	no
Reasoning and Arguing	5	W	no
Computer Vision	5	WR	no
Applied Signal Processing	5	WR	no
Scientific Visualization	5	R	no
Robotics	5	W	no
Medical Physics in Radiation Oncology	5	WR	no
Control Engineering	5	WR	no
Nuclear Medicine, SPECT and PET	5	W	no
Tools and Approaches in Systems Biology	5	WRP	yes
Neuromechanics	5	W	no

Colloid and Interface Science	5	W	no

c. Courses selected by students.

Upon request of the student, the Board of Examiners can give permission to follow a course that is not mentioned in 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 letter in which the permission is requested. In this letter, 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 4 weeks.

Appendix E Entry requirements and compulsory order of examinations (art. 3.2)

ule	successfully passing exams of the se elements
rated Lab Course Biomaterials	d and Interface Science ace Biology ce Characterization
cal Physics for Radiation Oncology	tion Physics
etic Resonance Physics	ples of Measurement Systems
ar Medicine, SPECT and PET	ples of Measurement Systems tion Physics
aterials 2	aterials 1

Appendix F 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 either Life Science & Technology with a major Biomedical Engineering or a Bachelor's degree in Physics or Applied Physics, with a minor in 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 I & II to catch up on the necessary biological background knowledge.

3. 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 programme based on the candidates previous education.

4. 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 D. All international candidates are screened by the BME Admissions Board, which suggests a pre-Masters programme based on the candidates previous education.

Admission to the different specializations

Admission requirements for the two specializations:

- specialization Prostheses & Implant Interface Technology: Colloids and Interface Science as elective in the first year
- specialization Clinical Physics: Electronics as elective in the first year

Appendix G Application deadlines for admission (art. 4.5.1)

ine of Application	EA students	tudents
dical Engineering	st 2013	st 2013

Decision deadlines (art. 4.5.3)

ine of Decision	EA students	tudents
dical Engineering	t 2013	t 2013