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Technische Universität Dresden
Biotechnologisches Zentrum

Study regulations for the consecutive master's program Nanobiophysics

of xxx

Pursuant to Article 36 of the Law on Institutions of Higher Education in the Free State of Saxony (Sächsisches Hochschulgesetz - SächsHSG) of December 10, 2008 (Saxon law gazette p. 900), amended by article 10 of the law of June 26, 2009 (Saxon law gazette pp. 375, 377), the Technische Universität Dresden enacts the study regulations below as statutes.

(In these regulations masculine designations of persons apply to female persons too.)

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§ 1
Scope

Based on the Saxon Law on Institutions of Higher Education and the examination regulations, these study regulations govern the aims, content, structure and organisation of the Master's program Nanobiophysics at the Technische Universität Dresden.

§ 2
Aims of the program

(1) On the basis of the discussed methods and different scientific approaches the students are able to conduct independent scientific research. The students can work on complex problems and solve them with scientific methods that may even lie beyond their current state of knowledge. The students have gained a subject-related expertise that is based on current research questions, methodological and analytical skills enabling them to independently broaden their scientific knowledge. In this, research methods and strategies play a central role. The students are able to think across scientific boundaries, communicate scientifically on a multidisciplinary level and solve economic problems.

(2) Through a sound training in physics, biology and polymer and material science from a nanoscopic view i.e. by using the wide variety of modern nanotechnological approaches and single-molecule based methods the students are able to understand molecular machines quantitatively, to use and manipulate them, to adapt and develop them for technical processes. The students know the basics of biophysics and bionanotechnology and are able to characterise and understand complex molecular machines as e.g. biomolecules with the help of nanotechnological approaches as well as harness these modules in technological systems and use them as templates or model systems for a bottom-up nanotechnology. They have acquired an analytical-technical profile.

(3) A graduate in Nanobiophysics has extensive knowledge of modern experimental and theoretical biophysics and a sound background and experimental experience with biological systems from biochemistry to molecular cell biology. He knows the most important concepts and methods in nanotechnology as well as different modern single-molecule methods in theory and practice and has a basic background in material sciences. Graduates are qualified to work in R&D labs/departments in an interdisciplinary context and are able to assess the economic aspects and relevance of their work.

§ 3
Admission requirements

To be qualified and, thus, eligible for admission to the Master's program Nanobiophysics according to par. 1, a candidate shall

1) furnish evidence of a first university degree in science (typically physics or biophysics) or engineering (typically Nanotechnology) or a subject with a similar inclination towards higher mathematics.

2) prove his proficiency in English, in case English is not his mother tongue. Evidence may be furnished through common international language tests (preferably IELTS: min. Level 6.0 or TOEFL: 550 points paper-based test).

3) furnish evidence of his qualification for the Master's program Nanobiophysics. This includes sound knowledge of the fundamentals of physics (mechanics, electrodynamics, optics, thermodynamics and quantum theory) as well as basic knowledge in chemistry and biology.

The admission requirements and admission procedure as well as the appointment and tasks of the selection committee are regulated by a separate document, i.e. the admission regulations.

§ 4
Beginning and duration of the program

(1) The program generally starts in the winter semester.

(2) The standard period of study is four semesters and includes attendance of the courses as well as self-study, practicals under supervision and the master examination.

§ 5
Types of courses

(1) The structure of the program is modular. The content of the individual modules is conveyed, consolidated and treated in-depth in lectures, seminars, tutorials, exercises and practicals.

(2) In lectures the students are introduced to the topics specified in the module descriptions. In the exercises students apply the theory that they learned in the lectures in exemplary sub-topics. Tutorials refer to the lectures and are intended for a thorough repetition of the lecture content and, if applicable, its in-depth treatment. Seminars are intended for developing the student's ability to deal with a problem mainly on the basis of literature, documentation or other papers, to present the results of his work in written or oral form. Practicals are intended for the practical application and in-depth treatment of the content conveyed in the lectures.

§ 6
Structure and organisation of the program

(1) The structure of the program is modular. Semester 1-3 are dedicated to coursework. The fourth semester is reserved for the writing of the Master's thesis and the defense.

(2) The master program is subdivided into the track Molecular Biophysics and the track Nanoscience and Nanotechnology. Students need to choose one track when they apply for the program. Students who choose the track Nanoscience and Nanotechnology will need to be admitted for the Erasmus Mundus program as well.

(3) The track Molecular Biophysics comprises of 12 obligatory modules one of which is designed with optional contents thus enabling the students to choose their own profile.

(4) In the track Nanoscience and Nanotechnology students need to spend their first year at KU Leuven in Belgium in the framework of a joint program. The details are specified in an

agreement between the cooperating universities. The course and exam requirements and are equivalent to the ones in the local master program Nanoscience and Nanotechnology at KU Leuven. The second year of the program comprises of 2 obligatory modules and 2 compulsory optional modules (students need to choose one) thus enabling the students to choose their own profile.

(5) The contents and qualification aims, the types of courses, the necessary requirements, work load and duration of the modules are specified in the module descriptions (appendix 1).

(6) The courses are taught in English.

(7) The appropriate distribution of the modules over semester 1-3 ensuring the timely completion of the program in the standard period of study, as well as type and scope of the courses and number and suggested standard date of the course requirements and exams are specified in the study schedule (appendix 2).

(8) Upon proposal by the study committee the Scientific Board of the BIOTEC may update the list of electives and the study schedule. The up-to-date list of electives is published at the beginning of the semester. The modified study schedule is valid for all students whom have been informed. The examination committee decides on exceptions to sentence 3.

§ 7
Contents of the program

(1) The master program Nanobiophysics is research-oriented.

(2) The program offers an interdisciplinary training in the field of molecular and cellular biophysics from a molecular or nanotechnological perspective.

(3) The track Molecular Biophysics covers topics from the fields of biology, biophysics and polymer physics. Nanotechnology is firstly approached from the angle of nanobiotechnology to pinpoint basic interdisciplinary concepts. The focus is on bio- and nanophysics. The students gain a broad overview over molecular and cellular biophysics and molecular nanostructures and –machines in theory and experiments. To stress the molecular approach, the program also covers modern single molecule techniques (single molecule optics, scanning probe techniques) that are fundamental in both bio- and nanophysics. The program has a strong practical focus.

(4) In the track Nanoscience and Nanotechnology students may choose one of two specialization options: biophysics or nanoelectronics. The specialization option Nanoelectronics covers molecular electronics, nanooptics, concepts of molecular modeling and molecular magnetism. The specialization option Biophysics covers applied biophysics, biophysical methods and cellular machines. In both specialization options students learn basic concepts of molecular biology and biochemistry.

§ 8
Credit Points

(1) The successful progression of the studies as well as the workload for the students is documented by the award of ECTS credits. One credit point is equivalent to a workload of

30 hours. The workload per academic year is typically 60 credit points, i.e. 30 per semester. The total workload for the whole program is 120 credit points and includes the types of courses, course requirements and exams as well as the master thesis and the defence as specified by the module descriptions.

(2) The module descriptions (appendix 1) specify how many credit points are awarded for each module. The credits are obtained when the module examination is passed. Article 28 of the examination regulations remains unaffected.

§ 9
Study counselling

(1) The general study counselling on study opportunities, enrolment procedures and general student affairs is provided by the Student Advisory Service of the Technische Universität Dresden and the BIOTEC student office. Continuous study counselling is provided by the university teachers who are active in the program and the BIOTEC study and examination office. This is to support students especially in matters of their individual study plans.

(2) Students who have not taken any examinations until the 3rd semester must take part in a study counselling session.

§10
Modification of module descriptions

(1) In order to ensure an optimal adaptation to changed conditions, the module descriptions can be modified in a simplified procedure except for the points "module name", "contents and qualification aims", "type of course", "requirements for the award of credits" as well as "credits and grades".

(2) Upon proposal of the study committee the Scientific Board of BIOTEC thus formally resolves upon changes in the module descriptions. The changes shall be published in accordance with the relevant provisions for publications.

§ 11
Transitional Rules

(1) These study regulations are applicable to the students enrolled from winter semester 2010/11.

(2) All students who have been enrolled before winter semester 2010/11 shall complete the program on the basis of the study regulations dated October 29, 2008.

§12
Entry into force and publication

The study regulations shall enter into force on October 1, 2010 and be published in the Official Publications (Amtliche Bekanntmachungen) of the Technische Universität Dresden.

Enacted on the basis of the resolution of the Scientific Board of BIOTEC on ... and the approval of the Rectorate of TU Dresden on xxx

Dresden, xxx

The Rector of the Technische Universität Dresden

Appendix 1: Module Descriptions for the Master's program Nanobiophysics

Module Number BT-NB 1.1.	**Module Name** Fundamentals of Biophysics	**Resp. Lecturer** Petra Schwille
Contents and qualification aims	The students are familiar with concepts of phenomenological thermodynamics: energy, entropy, transport phenomena, biologically active forces, classical reaction and enzyme kinetics, bioenergetics as well as membrane biophysics and basics of electrophysiology. They know the most important methods with respect to molecular, cellular and systems biophysics as well as structural methods (NMR, X-Ray), spectroscopy and microscopy, modern methods in biochemistry and proteomics. Students will have an overview over the most important concepts and the broad methodology of modern applied biophysics. They are able to select the best method(s) for a certain practical task and have background knowledge about their prerequisites and which systems to best apply them to.	
Type of course	4 SWS lecture, 2 SWS seminar, 1 SWS lab practical	
Requirements for study	basic knowledge in mathematics, particularly differential and integral calculus, simple differential equations on Bachelor level. Basic knowledge in classic physics (mechanics, electrodynamics, thermodynamics) on Bachelor level	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Molecular Biophysics	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination is a written examination (duration 90 minutes).	
Credits and grades	For the module 10 credit points can be acquired. The module grade is based on the grade of the written examination.	
Frequency of the course	The module is offered every academic year in winter semester.	
Workload	The workload is 300 working hours	
Duration of the module	1 semester	

Module Number BT-NB 1.2	**Module Name** Introduction to Polymer Physics and Soft Condensed Matter	**Resp. Lecturer** Jens-Uwe Sommer
Contents and qualification aims	Students know the fundamentals of applied polymer science and have an overview of polymer chemistry and biopolymers as a key aspect of nanotechnology. They are familiar with structure and characteristics of synthetic polymers and biopolymers, supramolecular organisation and dynamics of polymer structures, liquid crystals, hydrogels, stimuli-responsive polymers and colloidal systems. In practical applications in the lab they will practise and extend their knowledge about the subject. Students know how to prepare and apply natural and synthetic polymer materials in life sciences. The students also know theoretical principles of the physics of soft condensed matter • Theory of phase transitions, statistical models • liquid crystals: principles, ordered phases, statistical models • polymers: ideal polymer chains, excluded volume, states of polymer systems, dynamics, charge effects • biological polymer system: DNA and proteins, interactions between DNA and proteins – the lactose operon of Escherichia Coli, Chromatin	
Type of course	5 SWS lecture, 1 SWS lab practical, 1 SWS exercise	
Requirements for study	basic knowledge in fundamental physics and chemistry on Bachelor level	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Molecular Biophysics. It provides the basics for the specialisation module.	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination consists of 2 written examinations (duration each 90 minutes).	
Credits and grades	For the module 10 credit points can be acquired. The module grade is the unweighted average of the 2 grades.	
Frequency of the course	The module is offered every academic year, starting in winter semester.	
Workload	The workload is 300 working hours	
Duration of the module	2 semester	

Module Number BT-NB 1.3	**Module Name** Introduction to Biochemistry and Molecular Cell Biology	**Resp. Lecturer** Bernard Hoflack
Contents and qualification aims	Students know the fundamentals of biochemistry, organic chemistry, biomolecules and their structure, biosynthesis, gene expression and cellular organization, enzymology, network of primary metabolic pathways, mutagenesis, genetic architecture of selected biosyntheses. Students have an overview of basic concepts in molecular and cell biology, principles of cellular organization (compartmentalization), relevance and organization of protein networks for the generation of cellular structure and function. They are familiar with the coordination of cell-cell-communication, regulation of growth, differentiation and tissue-development. They know the most important biochemical, biomolecular and technical methods of cell biology. The students know the most important basics of biochemistry and molecular cell biology and are able to perform essential biochemical and cell and biomolecular lab activities themselves.	
Type of course	4 SWS lecture, 2 SWS exercise, 2 SWS lab practical	
Requirements for study	basic knowledge in physics, biology and chemistry on Bachelor level	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Molecular Biophysics. It provides the basics for the specialisation module.	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination consists of • an oral examination (individual exam, duration 20 minutes) • and a lab protocol	
Credits and grades	For the module 10 credit points can be acquired. The module grade is the weighted average of the 2 grades: • 75% oral exam • 25% lab protocol	
Frequency of the course	The module is offered every academic year, starting in winter semester.	
Workload	The workload is 300 working hours	
Duration of the module	2 semester	

Module Number BT-NB 1.4	**Module Name** Elements of Nanobiotechnology	**Resp. Lecturer** Gianaurelio Cuniberti
Contents and qualification aims	Students know the bottom-up generation of synthetic nanostructures with the help of proteins and DNA as well as structural, mechanical and electronic characteristics of DNA and proteins, DNA as construction material and the controlled generation of hybrid nanostructures using biomolecular templatings. They are familiar with biomimetic cluster synthesis, nano crystals for biological detection, new principles of (bio)molecular electronics, manipulation of nanoparticles in 3 dimensions and latest research questions and problems in the context of nanotechnology and bionanotechnology Students will be in command of basic knowledge of bionanotechnology. They will be able to comprehend the relevance of complex natural nanostructures for technical applications. In turn, they will have gained an understanding of how nanotechnological methods may be used in biology. Thanks to individually prepared papers and the subsequent discussions, students are able to communicate in a scientific manner.	
Type of course	2 SWS lecture, 2 SWS seminar, 1 SWS lab practical	
Requirements for study	basic knowledge in physics on Bachelor level, basic knowledge in biology and chemistry on Abitur level	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Molecular Biophysics. It provides the basics for the module Applied Nanotechnology	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination consists of • an oral examination (individual exam, duration 20 minutes) • an oral presentation • and a lab protocol Passing the module requires that the oral exam is evaluated with min. "sufficient" (4.0) or better.	
Credits and grades	For the module 6 credit points can be acquired. The module grade is composed of the weighted average of: • 50% oral exam • 35 % oral presentation • 15% lab protocol	
Frequency of the course	The module is offered every academic year in winter semester.	
Workload	The workload is 180 working hours	
Duration of the module	1 semester	

Module Number BT-NB 1.5	**Module Name** Concepts of Molecular Modelling	**Resp. Lecturer** Gianaurelio Cuniberti
Contents and qualification aims	The students know basics of molecular dynamics simulation for the theoretical description of elements of bio- and nanophysics. They gain an overview of classic mechanics with the help of numerical methods and the modelling of interatomic forces (classically and quantum-mechanically). They are able to describe potential energy surfaces, to discuss different observables, and are familiar with the basics of Car-Parinello- and path integral simulations. The students know mathematical approaches to characterise the dynamics of molecules quantitatively and are able to model them in computer programs.	
Type of course	2 SWS lecture, 2 SWS exercise, 2 SWS lab practical	
Requirements for study	basic knowledge in mathematics and physics on Bachelor level	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Molecular Biophysics. It provides the basics for the module Nanostructured Materials.	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination consists of: • an oral examination (individual exam, duration 20 minutes) • and a modelling project	
Credits and grades	For the module 6 credit points can be acquired. The module grade is the unweighted average of the 2 grades. Passing the module requires that the oral examination is graded with min. "sufficient" (4.0) or better.	
Frequency of the course	The module is offered every academic year in winter semester.	
Workload	The workload is 180 working hours	
Duration of the module	1 semester	

Module Number BT-NB 2.1	**Module Name** Applied Nanotechnology	**Resp. Lecturer** Bernd Büchner
Contents and qualification aims	Students know molecular pathways of different proteins and their assemblies functioning in the context of the biological organism and the possibility of transferring these mechanisms and functions to nanotechnological questions. They know basics of the molecular structure and functional mechanisms of proteins and how to transform transient forms of biochemical energy into storable forms. They know protein-induced diseases caused by failure of proteins in the functional chain, and strategies to correct these dysfunctions. The students are familiar with the requirements for the in vitro application of proteins for purposes in nanotechnology. Furthermore, they are introduced to the fabrication and the basic structural, electronic and magnetic characteristics and peculiarities of various nanostructures as for example cluster, semi-conductor nanostructures, molecules and nanotubes. The students will have acquired an overview over the functioning mode of natural and synthetic nanostructures and –machines. They are able to inter-relate the knowledge of nanotechnology, molecular cell biology and biochemistry to apply them in continuative surveys and research projects in the context of nanobiophysics.	
Type of course	4 SWS lecture, 2 SWS seminar	
Requirements for study	basic knowledge in polymer science, biochemistry, molecular and cell biology and bionanotechnology on Bachelor level, competences and skills of the module Elements of Nanobiotechnology	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Molecular Biophysics. It provides the basics for the module Specialisation Module.	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination consists of • an oral presentation • and an oral examination (individual exam, duration 20 minutes)	
Credits and grades	For the module 6 credit points can be acquired. The module grade is the unweighted average of the 2 grades.	
Frequency of the course	The module is offered every academic year in summer semester.	
Workload	The workload is 180 working hours	
Duration of the module	1 semester	

Module Number BT-NB 2.2	**Module Name** Nanostructured Materials	**Resp. Lecturer** Gianaurelio Cuniberti
Contents and qualification aims	The students know the fundamentals of physics with respect to the fabrication and the characteristics of nanostructured materials, particularly the synthesis of clusters and nanotubes, nanostructuring with the help of electron beam lithography, optical lithography and scanning microscopy. Furthermore, they know the theoretical fundamentals of scanning force microscopy, chemical scanning force microscopy and optical near field microscopy. They are familiar with relevant quantum effects in mesoscopic systems, concepts of scaling laws, density of states and giant magneto-resistance. They know about electron transport in low dimensional solid-state materials and single electronics.	
Type of course	2 SWS lecture, 2 SWS exercise, 2 SWS lab practical	
Requirements for study	basic knowledge in mathematics, and theoretical physics on Bachelor level, competences and skills of the module Concepts of Molecular Modelling	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Molecular Biophysics. It provides the basics for the module Specialisation Module.	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination consists of • an oral examination (individual exam, duration 20 minutes) • and a modelling project	
Credits and grades	For the module 6 credit points can be acquired. The module grade is the unweighted average of the 2 grades. Passing the module requires that the oral examination is graded with at least "sufficient" (4.0).	
Frequency of the course	The module is offered every academic year in summer semester.	
Workload	The workload is 180 working hours	
Duration of the module	1 semester	

Module Number BT-NB 2.3	**Module Name** Advanced Biophysics	**Resp. Lecturer** Stephan Grill
Contents and qualification aims	Students know the statistical physics of bio-molecules and membranes as well as stochastic processes and fluctuations. They are familiar with active transport processes and molecular motors, the physics of the cytoskeleton, collective behaviour, cellular oscillations and biological self-organization. Students have basic knowledge of theoretical biophysics allowing them to systematically and quantitatively address selected biophysical problems. Students gain a historical view on the development and the motivation behind single molecule detection: single molecule spectroscopy in solid host-guest-systems, spectral jumps, spectral hole burning, low temperature experiments, static and dynamic heterogeneity, ergodic theory, analysis of distributions rather than mean values, access to intermediate or transient states. They have extended knowledge on applications of single molecule methods such as fluorescence spectroscopy and microscopy, force spectroscopy, scanning probe microscopy for the detection, analysis and manipulation of single molecules e.g. protein folding, conformational fluctuations, enzyme kinetics, markovian and non-markovian behavior. They know common principles of Scanning Probe Microscopy (SPM) based on short range forces and principle experimental setups. They are familiar with concepts and function modes of scanning near-field microscopy (SNOM), electrochemical scanning tunneling microscopy (ESTM), scanning tunneling microscopy (STM), atomic force microscopy (AFM) and magnetic force microscopy (MFM). Furthermore, the students know the most important optical techniques for single molecule imaging and tracking by microscopy and spectroscopy: confocal setup, fluorescence correlation spectroscopy (FCS), coincidence analysis, multi-parameter burst-analysis, lifetime measurements, anisotropy measurements, fluorescence resonance energy transfer (FRET): Far-field and TIRF microscopy. Single particle tracking in 2D on membrane systems, analysis of motor proteins in surface mobility assays, optical and magnetic tweezers Students know theoretical and practical aspects of single molecule analysis and manipulation, and know the challenges of their applications to biological systems. They are able to choose the right method or combinations of methods for a certain problem, and know the experimental conditions under which they can be applied.	

Type of course	4 SWS lecture, 1 SWS exercise, 2 SWS seminar, 2 lab practicals (1 week each)
Requirements for study	basic knowledge in statistical physics on Bachelor level, basic knowledge in polymer science, biochemistry and molecular cell biology on Abitur level
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Molecular Biophysics.
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination consists of • an oral examination (individual exam, duration 20 minutes) • an oral presentation • and 2 lab protocols
Credits and grades	For the module 12 credit points can be acquired. The module grade is the weighted average of: • 2/5 oral exam • 2/5 oral presentation • 1/5 lab protocols
Frequency of the course	The module is offered every academic year, starting in summer semester.
Workload	The workload is 360 working hours
Duration of the module	2 semester

Module Number BT-NB 3.1	**Module Name** Lab Rotation Biophysics	**Resp. Lecturer** Petra Schwille
Contents and qualification aims	In this module, students work on a short scientific project from the field of experimental biophysics in an in-depth lab practical. The students gain practical experience with topical scientific methods in biophysical research teams and will be enabled to apply relevant technologies and laboratory routines.	
Type of course	2 weeks block lab practical	
Requirements for study	basic knowledge in mathematics (esp. Calculus), simple differential calculus equations, basic knowledge in classical physics (mechanics, electrodynamics, thermodynamics) on Bachelor level	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Molecular Biophysics, and a compulsory elective in the track Nanoscience and Nanotechnology/specialisation Biophysics. It provides the basics for the master thesis.	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination is a lab protocol (max. 4 pages).	
Credits and grades	For the module 6 credit points can be acquired. The module grade is based on the grade for the lab protocol.	
Frequency of the course	The module is offered every academic year in winter semester.	
Workload	The workload is 180 working hours	
Duration of the module	1 semester	

Module Number BT-NB 3.2	**Module Name** Lab Rotation Nanophysics	**Resp. Lecturer** Gianaurelio Cuniberti
Contents and qualification aims	In this module, students work on a short scientific project from the field of nanotechnology or nanophysics in an in-depth lab practical. The students gain practical experience with topical scientific methods in nanoscientific research teams and will be enabled to apply relevant technologies and laboratory routines.	
Type of course	2 weeks block lab practical	
Requirements for study	Knowledge of polymer science, biochemistry, molecular cell biology and bionanotechnology, basics of mathematics and theoretical physics on Bachelor level, programming skills on Abitur level	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Molecular Biophysics. It provides the basics for the master thesis.	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination is a lab protocol (max. 4 pages).	
Credits and grades	For the module 6 credit points can be acquired. The module grade is based on the grade for the lab protocol.	
Frequency of the course	The module is offered every academic year in winter semester.	
Workload	The workload is 180 working hours	
Duration of the module	1 semester	

Module Number BT-NB 3.3	**Module Name** Lab Rotation Choice	**Resp. Lecturer** Petra Schwille
Contents and qualification aims	In this module, students work on a short scientific project from any of the offered fields, e.g. biology, chemistry, or theoretical biophysics in an in-depth lab practical. The students gain practical experience with topical scientific methods in research teams and will be enabled to apply relevant technologies and laboratory routines.	
Type of course	2 weeks block lab practical	
Requirements for study	Knowledge of polymer science, biochemistry, molecular cell biology and bionanotechnology, basics of mathematics and theoretical physics on Bachelor level, programming skills on Abitur level	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Molecular Biophysics. It provides the basics for the master thesis.	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination is a lab protocol (max. 4 pages).	
Credits and grades	For the module 6 credit points can be acquired. The module grade is based on the grade for the lab protocol.	
Frequency of the course	The module is offered every academic year in winter semester.	
Workload	The workload is 180 working hours	
Duration of the module	1 semester	

Module Number BT-NB E	**Module Name** Specialisation Module	**Resp. Lecturer** Petra Schwille
Contents and qualification aims	The students know selected current nano- and biophysical research issues. Students need to choose 2 electives for this module so as to create an own specific profile within the master's program. The selection of courses may vary according to topical academic questions and recent developments in the diverse subjects. The students gain an in-depth knowledge of the selected research fields. They will be able to orientate themselves within different areas of research and know about the latest developments in the optional required subjects. They will be able to make an adequate decision regarding the topic of their Master's theses.	
Type of course	4 SWS lecture. The subjects need to be chosen from the list of electives offered each winter term.	
Requirements for study	Competences and skills of the modules Introduction to Polymer Science and Soft Condensed Matter, Introduction to Biochemistry and Molecular Cell Biology, Applied Nanotechnology and Nanostructures Materials.	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Molecular Biophysics.	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination consists of 2 oral exams (individual exam, duration 20 min each)	
Credits and grades	For the module 6 credit points can be acquired. The module grade is the unweighted average grade of the 2 grades.	
Frequency of the course	The module is offered every academic year in winter semester. Courses in the previous summer semester can also be chosen.	
Workload	The workload is 180 working hours	
Duration of the module	1 semester	

Module Number BT-NB E1	**Module Name** Molecular Biophysics	**Resp. Lecturer** Petra Schwille
Contents and qualification aims	The students are familiar with concepts of phenomenological thermodynamics: energy, entropy, transport phenomena, biologically active forces, classical reaction and enzyme kinetics, bioenergetics as well as membrane biophysics and basics of electrophysiology. They know the most important methods with respect to molecular, cellular and systems biophysics as well as structural methods (NMR, X-Ray), spectroscopy and microscopy, modern methods in biochemistry and proteomics. Students will have an overview over the most important concepts and the broad methodology of modern applied biophysics. They are able to select the best method(s) for a certain practical task and have background knowledge about their prerequisites and which systems to best apply them to. The students are familiar with functional biomolecular units as machines with the specific aim to use them in more complex technological or medical processes as nanoscale functional elements. The students have an overview of potential applications of the proteins of fibrillar structures, applications of motor proteins, applications of motor proteins of the cytoskeleton, enzymes: classification, kinetics, control and use, applications of viruses, prediction, design and engineering of cellular machines. They know how to write a grant proposal. The students have an interdisciplinary research and development competence, which qualifies them both for scientific intentions (master thesis or rather subsequent doctorate) as well as for an activity in the R&D field of a biotechnology company.	
Type of course	4 SWS lecture, 2 SWS seminar, 2 SWS exercise and 2 SWS lab practical	
Requirements for study	basic knowledge in mathematics, particularly differential and integral calculus, simple differential equations on Bachelor level. Basic knowledge in classic physics (mechanics, electrodynamics, thermodynamics) on Bachelor level, basics in biology on Bachelor level	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Nanoscience and Nanotechnology	

Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination is a written examination (duration 90 minutes).
Credits and grades	For the module 9 credit points can be acquired. The module grade is based on the grade of the written examination.
Frequency of the course	The module is offered every academic year in winter semester.
Workload	The workload is 270 working hours
Duration of the module	1 semester

Module Number BT-NB E2	**Module Name** Biological Oriented Module	**Resp. Lecturer** Petra Schwille
Contents and qualification aims	The students know research issues and recent developments in selected research areas of molecular and cell biology, developmental or systems biology and surface chemistry. By choosing a number of elective, the students create an individual profile within the master's program. They will be able to orientate themselves within different areas of research and know about the latest developments in the selected subjects. They will be able to make an adequate decision regarding the topic of their Master's theses.	
Type of course	4 SWS lecture. The subjects need to be chosen from the list of electives offered each winter term.	
Requirements for study	None	
Practical use of the module	compulsory module of the master's program Nanobiophysics, track Nanoscience and Nanotechnology	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination consists of 2 oral exams (individual exam, duration 20 min each)	
Credits and grades	For the module 6 credit points can be acquired. The module grade is the unweighted average grade of the 2 grades.	
Frequency of the course	The module is offered every academic year in winter semester. Courses in the previous summer semester can also be chosen.	
Workload	The workload is 180 working hours	
Duration of the module	1 semester	

Module Number BT-NB E3	**Module Name** Nanooptics and Molecular Magnetism	**Resp. Lecturer** Lukas Eng
Contents and qualification aims	The students are familiar with: field of a hertz-dipole, evanescent field, far field, field distribution in focus of linear, circular, radial and azimuthal polarisation, diffraction, principles and applications of the near-field scanning optical microscopy, optical micro-cavity, impact of an optical field in a closed space on the fluorescence properties of a molecule, generation of optical near field on interfaces and through nanostructures: optical aperture, metallic nanoparticles, surface plasmon, optical antennae. The module introduces modern optics on the basis of single molecule detection. Furthermore, the students know fundamental aspects of magnetism, magnetic resonance, thermodynamics, magnetization, magnetic exchange, anisotropy on the molecular scale, molecular and nanoscale magnets in memory technology and medicine. They know modern aspects of magnetism of molecules and on the nanometer scale.	
Type of course	4 SWS lecture	
Requirements for study	Knowledge of theoretical and experimental biophysics on Bachelor level	
Practical use of the module	compulsory optional module of the master's program Nanobiophysics, track Nanoscience and Nanotechnology, specialisation Nanoelectronics	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination consists of an oral exam (individual exam, duration 20 min) in one of the 2 topics (choice of the student)	
Credits and grades	For the module 6 credit points can be acquired. The module grade is based on the grade for the oral exam.	
Frequency of the course	The module is offered every academic year in winter semester.	
Workload	The workload is 180 working hours	
Duration of the module	1 semester	

Module Number BT-NB E4	**Module Name** Molecular Electronics	**Resp. Lecturer** Gianaurelio Cuniberti
Contents and qualification aims	The students know the fundamentals of molecular electronics, particularly experimental methods, physical effects and theoretical instruments. They are familiar with single molecule electronics, scanning probes and break junction techniques, transport mechanisms on the nanoscale, molecular components (diodes, transistors, sensors) and molecular structures. The students know the most important experimental and theoretical methods for the analysis of charge transfer on the molecular scale.	
Type of course	2 SWS lecture, 2 SWS exercise, 2 SWS seminar	
Requirements for study	Basics of mathematics and physics on Bachelor level	
Practical use of the module	compulsory optional module of the master's program Nanobiophysics, track Nanoscience and Nanotechnology, specialisation Nanoelectronics	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination consists of • an oral exam (individual exam, duration 20 min) • and an oral presentation	
Credits and grades	For the module 9 credit points can be acquired. The module grade is the weighted average of: • 70% oral exam • 30% oral presentation	
Frequency of the course	The module is offered every academic year in winter semester.	
Workload	The workload is 270 working hours	
Duration of the module	1 semester	

Module Number BT-NB E5	**Module Name** Broadening Module	**Resp. Lecturer** Petra Schwille
Contents and qualification aims	The students know selected current nano- and biophysical research issues. Based on their choice of courses, the students gain an in-depth knowledge of the selected research fields. They will be able to orientate themselves within different areas of research and know about the latest developments in the chosen subjects. They will be able to make an adequate decision regarding the topic of their Master's theses.	
Type of course	6 SWS lecture. The subjects need to be chosen from the list of electives offered each winter term.	
Requirements for study	None	
Practical use of the module	compulsory optional module of the master's program Nanobiophysics, track Nanoscience and Nanotechnology, specialisation Biophysics	
Requirements for the award of credits	The credits are awarded if the module examination is passed. The module examination consists of 3 oral exams (individual exams, duration 20 min each)	
Credits and grades	For the module 9 credit points can be acquired. The module grade is the unweighted average grade of the 3 grades.	
Frequency of the course	The module is offered every academic year in winter semester. Courses in the previous summer semester can also be chosen.	
Workload	The workload is 270 working hours	
Duration of the module	1 semester	

Annex 2 – Study schedule of the master program Nanobiophysics
defining type and scope of the courses (in SWS) as well as number of exam requirements whose type, scope and organisation are specified in the module descriptions.

Track Molecular Biophysics

Number of Module	**Title of Module**	**1. Semester**	**2. Semester**	**3. Semester**	**4. Semester**	**Credits**
		L/E/S/P/T	**L/E/S/P/T**	**L/E/S/P/T**	**L/E/S/P/T**	
BT-NB 1.1	Fundamentals of Biophysics	4/0/2/1/0 1xPL				10
BT-NB 1.2	Introduction to Polymer Physics and Soft Condensed Matter	2/0/0/1/0 1xPL	3/1/0/0/0 1XPL			10
BT-NB 1.3	Introduction to Biochemistry and Molecular Cell Biology	2/0/0/2/0 1xPL	2/2/0/0/0 1xPL			10
BT-NB 1.4	Elements of Nanobiotechnology	2/0/2/1/0 3xPL				6
BT-NB 1.5	Concepts of Molecular Modelling	2/2/0/2/0 2xPL				6
BT-NB 2.1	Applied Nanotechnology		4/0/2/0/0 2XPL			6
BT-NB 2.2	Nanostructured Materials		2/2/0/2/0 2XPL			6
BT-NB 2.3	Advanced Biophysics		4/1/2/0/0 2xPL	0/0/0/4/0 1xPL		12
BT-NB 3.1	Lab Rotation Biophysics			2 weeks block course 1XPL		6
BT-NB 3.2	Lab Rotation Nanophysics			2 weeks block course 1XPL		6
BT-NB 3.3	Lab Rotation Choice			2 weeks block course 1XPL		6
BT-NB- E	Specialization module			4/0/0/0/0 2XPL		6
					Master thesis	29
					defense	1
Total credits		30	30	30	30	**120**

SWS: Semesterwochenstunden (hours per week, 1SWS=45 min per week over the whole semester), PL: Prüfungsleistung (examination)
L: Lecture, E: Exercise, S: Seminar, P: Practical, T: Tutorial

Track Nanoscience and Nanotechnology

Number of Module	Title of Module	1. Semester*	2. Semester*	3. Semester	4. Semester	Credits
		L/E/S/P/T	L/E/S/P/T	L/E/S/P/T	L/E/S/P/T	
BT-NB E1	Molecular Biophysics			4/2/2/2/0 1x PL		9
BT-NB E2	Biological Oriented Module			4/0/0/0/0 2xPL		6
Specialisation option Nanoelectronics**						
BT-NB E3	Nanooptics and Molecular Magnetism			4/0/0/0/0 1x PL		6
BT-NB E4	Molecular Electronics			2/2/2/0/0 2x PL		9
Specialisation option Biophysics**						
BT-NB 3.1	Lab Rotation Biophysics			2 weeks block course 1XPL		6
BT-NB E5	Broadening Module			6/0/0/0/0 3xPL		9
					Master thesis	29
					defense	1
Total credits		30	30	30	30	**120**

* 1st year at KU Leuven
** students choose 1 out of the 2 specialisation options
SWS: Semesterwochenstunden (hours per week, 1SWS=45 min per week over the whole semester), PL: Prüfungsleistung (examination)
L: Lecture, E: Exercise, S: Seminar, P: Practical, T: Tutorial