QUALIFICATION CHARACTERISTICS
Of the " BIOINFORMATICS "
FOR DEGREE "MASTER "
With professional qualification "Master in Informatics"

I. Requirements for professional skills and competencies for enrolled students:

Students accepted for training in this specialty must present diplomas degree in "Informatics" in degree "Bachelor" . The procedure for submission of documents and admission is determined by the Faculty of Mathematics and Natural Sciences .

II. Requirements for professional skills and competencies of graduates :

SWU "Neofit Rilski" prepare qualified specialists in informatics who can apply their knowledge and skills in science , culture, education and economy in southwestern Bulgaria , the country and abroad.

Experts “Master of Bioinformatics” can successfully implement such as programmers, system and network administrators and designers, graphic designers , researchers , specialists in hardware and software technologies . Graduates of the academic title Master of Bioinformatics receive :

- **in-depth knowledge in the field of bioinformatics .**
- **Ability to use analytical data and application of theoretical methods , mathematical modeling and computational simulation techniques to biological systems and processes.**
- **interdisciplinary training and research opportunities in various areas of bioinformatics, including topics such as DNA and protein databases, protein structure and function, computational neurology, biomechanics, genetics and management of agricultural and natural systems .**
- **solid theoretical knowledge in the field of informatics and mathematics , and solid practical skills that meet the latest European standards.**
- **formation of affinity and capacity for independent research and design activities .**
- **basis for continuing education in the educational and scientific degree "Doctor"**
- **good opportunities for such specialists in the country and abroad.**
- **mindset and affinity (openness) to the rapidly changing requirements of the information society .**

Master's program is consistent with a similar program with the University of Berkeley (USA).

III. Requirements for the preparation of graduates

Graduates of master's degree should possess the following knowledge , skills and competencies:

- **conduct independent research to model real processes and computer automated information services.**
- **use mathematical models and software packages in solving real problems, engineering and management problems in continuous and discrete macrosystems**
- **participate in the development of basic software and packages.**
- **adapt and implement computer programs and systems.**
- **solve optimization problems of different nature .**

Qualification characteristics of the " Informatics" in degree "Master " with professional qualification of "Master in Informatics" is the basic document that defines the development of curricula and syllabuses . It is consistent with the regulations in the field of higher education in Bulgaria .

First year			
First semester	ECTS credits	Second semester	ECTS credits
Compulsory courses		***Compulsory courses***	
Introduction to Bioinformatics	3	Molecular Genetics	4.5
Proteins and Enzymes	6	Computer Genomics	3.5
Fundamentals of Molecular Biology	6	Theoretical modeling in genomics	3
Algorithms in Bioinformatics	3	Optional course 3	2
Optional course 1	6	Optional course 4	2
Optional course 2	6	Preparation for a written state exam or thesis defense	15
Optional courses			
Group 1:		***Optional courses***	
Introduction in Biopython		Group 3:	
Introduction in BIOJAVA		Computer molecular modeling	
Group 2:		Bioinformatics computer lab	
Operations Research		Group 4:	
Contemporary methods in computational biology		Quantitative Pharmacology	
Statistical Analysis		Script languages	
	Total 30		Total 30

INTRODUCTION TO BIOINFORMATICS

Semester: 1 semester

Course Type: lectures

Hours per Week/FS/SS: 2 lecture hours per week/FS

ECTS Credits: 3 credits

Course Status: Compulsory Course in the Bioinformatics M.S. Curriculum

Course Description: Bioinformatics is a relatively new interdisciplinary scientific field that operates at the intersection of biology (molecular biology, biotechnology, genetic engineering), Chemistry (Biochemistry), mathematics, engineering, computer science, as well as systematic and computational biology. The main objectives of the course is to equip students with practical skills and knowledge to work with specialized software programs and search for information in academic libraries. The course will demonstrate approaches to the modeling of biological systems and functions, analysis of laboratory data, generate models based on accumulated data from experiments exploring new data using mathematical models, identifying patterns in experimental data, predicting the functions of genes and proteins.

Course Objectives: To ensure familiarity with basic computer concepts and their everyday use in a biological laboratory setting. To acquaint the students with the structure of molecular sequence databases and with the methods to analyse their contents.

Teaching Methods: lectures Requirements/Prerequisites: Informatics, Biology

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Exam: coordinated with lecturer and Student Service Department
References:

1. Introduction to Bioinformatics, Oxford University Press
2. Bioinfromatics - sequence and genome analysis, Cold Spring Harbor Laboratory Press
3. Bioinformatics: A practical guide to the analysis of genes and proteins, John Wiley & Sons
4. Bioinformatics: genes, proteins and computers. Ch. Orengo, D. Jones, J. Thornton
5. Abbreviation:

CONTEMPORARY METHODS IN COMPUTATIONAL BIOLOGY

Semester: 1 semester

Course Type: lectures and tutorials

Hours per Week/FS/SS: 3 lecture hours and 1 lab hour per week/FS

ECTS Credits: 6 credits

Course Status: Optional Course in the Bioinformatics M.S. Curriculum

Course Description: The proposed course will examine the possibilities of computer information systems for the management and regulation of biological information. The main objectives of the course are for students to acquire theoretical and practical skills and knowledge to work with special software for computer modeling in biology.The course will be a comparative analysis between the computer method and computer methods in biology.

Course Objectives: Students will learn about the computational problems in the emerging areas of Bioinformatics, Computational Biology, and Genomics. The students will have varied backgrounds of engineering, computer science, and the life sciences. These students will be prepared to work in the interdisciplinary area marrying recent advances in high-performance computing and networking, with the exploding information resources of the human genome and related data.

Teaching Methods lectures and tutorials Requirements/Prerequisites: Informatics, Biology

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Course: by request at the end of the previous academic year **Registration for the Exam:** coordinated with lecturer and Student Service Department

References:

1. Journal of the American Medical Informatics Association • Medical Decision Making
2. Journal of Computational Biology
3. Computer Biology, http://genomebiology.com/2010/11/5/207, 2012

COMPUTER MOLECULAR MODELING

Semester: 2 semester

Course Type: lectures

Hours per Week/FS/SS: 2 lecture hours per week/FS

ECTS Credits: 4 credits Lecturer: Assist.

Course Status: Optional Course in the Bioinformatics M.S. Curriculum

Course Description: The proposed course will address some basic methods for designing and solving scientific problems. The main objectives of the course is to equip students with practical skills and knowledge to work with specialized software programs and search for information in academic libraries. The course will demonstrate the approach to the mathematical modeling of real problems and ways of solving them. The models will be tested in practice. Examples of the construction of these models are: modeling of the genetic code to predict the secondary structure of RNA and the like.

Course Objectives:
Upon completing the course, the student should be able to:

- Describe the basic theoretical aspects of molecular modeling techniques
- Evaluate the successes and limitations of molecular modeling
- Analyze the results of molecular modeling calculations
- Evaluate and discuss current literature related to molecular modeling

Teaching Methods: lectures

Requirements/Prerequisites: Computer skills, Biology

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Course: by request at the end of the previous academic year

Registration for the Exam: coordinated with lecturer and Student Service Department

References:

1. Basak S., Grunwald G., Niemi G., Use of Graph-Theoretic and Geometric Molecular Descriptors in Structure-Activity Relationships, in From Chemical Topology toThree- Dimensional Geometry, edited by Balaban A., Plenum Press N.Y., 1997
2. Baxter M.J., Beardah C.C.,Beyond the histogram - improved approaches to simple data display in archaeology using kernel density estimates, Department of Mathematics, Statistics and Operationa lResearch, The Nottingham Trent University, http://science.ntu.ac.uk/msor/ccb/romenew.ps
3. Baxter M.J., Beardah C.C.,MATLAB Routines for Kernel Density Estimation and the Graphical Representation of Archaeological Data Department of Mathematics,
4. Statistics and Operational Research, The Nottingham Trent University, 2010, http://science.ntu.ac.uk/msor/ccb/caarev.ps
5. Boething R.S., Mackay D. (editors), Handbook of Property Estimation Methods for Chemicals. Environmental and Health Sciences, Lews Publishers, 2000
6. Bohacek R.S., McMartin C., Multiple Highly Diverse Structures Complementary to Enzyme Binding Sites: Results of Extensive Application of a de Novo Design Method Incorporating Combinatorial Growth

STATISTICAL ANALYSIS

Semester: 1 semester

Course Type: lectures and tutorials

Hours per Week/FS/SS: 3 lecture hours and 1 lab hour per week/FS

ECTS Credits: 4 credits

Course Status: Optional Course in the Bioinformatics M.S. Curriculum

Course Description: The proposed course will address some basic methods for statistical data analysis. The main objectives of the course are for students to acquire theoretical and practical skills and knowledge to work with specialized software for statistical analysis. The course will demonstrate the approach to the mathematical modeling of real problems and ways of solving them. The models will be tested in practice.

Course Objectives: Parametric and nonparametric methods in research for graduate students majoring in natural sciences or social sciences. The topics are selected from, but not restricted to, contingency tables and chi-squared tests, correlation, simple linear regression and multiple regression, design and analysis of variance, logistic regression, and introduction to multivariate statistics. A major statistical package is used as a tool to aid calculations for many of the techniques.

Teaching Methods: lectures and tutorials Requirements/Prerequisites: Computer skills, Algebra

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Course: by request at the end of the previous academic year Registration for the Exam: coordinated with lecturer and Student Service Department

References:

1. Statistical Design and Analysis of Experiments, Robert L. Mason, 2003
2. An Introduction to Statistical Methods and Data Analysis, Belmont, 1997
3. Norman Matloff. The Art of R Programming, 2011

COMPUTER GENOMICS

Semester: 2 semester

Course Type: lectures and tutorials

Hours per Week/FS/SS: 2 lecture hours and 1 lab hour per week/FS

ECTS Credits: 4 credits

Course Status: Compulsory Course in the Bioinformatics M.S. Curriculum

Course Description: The proposed course will address some basic methods for designing and solving scientific problems. The main objectives of the course is to equip students with practical skills and knowledge to work with specialized software and computational genomics. The course will demonstrate approaches to mathematical models in molecular quantum mechanics and the use of specialized software in genomics. The models will be tested in practice. Examples of the construction of these models are: modeling of the genetic code to predict the secondary structure of RNA and the like.

Course Objectives: Understanding the principles of genomic analysis of eukaryotes at various levels (DNA, mRNA and protein), and bioinformatics methods used in these analysis.

Teaching Methods: lectures and tutorials Requirements/Prerequisites: Informatics, Biology

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Exam: coordinated with lecturer and Student Service Department
References:

1. Computer Biology, http://genomebiology.com/2010/11/5/207, 2012
2. Garey M.R., Jonson D. S. Computational Complexity, 1994
3. Knuth D.E. Postscript about NP-hard Problems, SIGACT News, 1974.
4. Dr Wybo J. Dondorp, The ‘thousand-dollar genome’ 2013г. USA, http://www.gezondheidsraad.nl/sites/default/files/201015E.pdf
5. Introduction in quantum mechanics http://cdn.preterhuman.net/texts/science_and technology/ physics/Introduction%20to%20Quantum%20Mechanics.pdf, 2010
6. Genome Profiling for Genetic Marker Discovery, Series Ed.: Walker, John M., 2013

MOLECULAR GENETICS

Semester: 2 semester

Course Type: lectures and tutorials

Hours per Week/FS/SS: 4 lecture hours and 2 lab hour per week/FS

ECTS Credits: 5 credits

Course Status: Compulsory Course in the Bioinformatics M.S. Curriculum

Course Description: "Molecular Genetics" is a theoretical discipline that focuses on the study of molecular mechanisms of preservation, development and realization of genetic information. Problem may be selected in the fields of molecular genetics, genomics, cell biology, developmental biology and plant sciences.

Course Objectives:
Students will be able:

- To understand basic principles of molecular genetics

- To apply such principles to ecological, environmental and conservationresearch
- To interpret genetic data in an applied context
- To communicate and disseminate the results of their research

Teaching Methods: lectures and tutorials Requirements/Prerequisites: Chemistry, Biology

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Exam: coordinated with lecturer and Student Service Department

References:

1. Strachan T., Read A., Human molecular genomics, 4th Edition, Taylor & Francis, Inc., 2010.
2. Murray RK., Granner DK, Mayes P and Rodwell VW Harper's Biochemistry, 25th edition, MC Graw Hill, 2000.

OPERATIONS RESEARCH

Semester: 1 semester
Course Type: lectures and tutorials
Hours per Week/FS/SS: 3 lecture hours and 1 lab hour per week/FS
ECTS Credits: 6 credits

Course Status: Optional Course in the Bioinformatics M.S. Curriculum, period of study 2 semesters

Course Description: The course in Operations Research includes the following main topics: basic concepts in Operations Research; deterministic models, models with uncertainty and stochastic models, especially the facility location (production planning) problem in deterministic and stochastic version; stochastic programming and stochastic quasigradient methods; dynamic programming and Bellman's principle of optimality; the concept of algorithm, algorithmic (computational) complexity and NP-hard problems; discrete (including integer) optimization problems and network optimization; scheduling theory; queueing theory; game models, matrix game theory and the relationship between matrix game theory and linear programming; decision making theory; fuzzy sets and their application to decision making and management; multi-objective (vector) optimization and Pareto optimality; Markov processes (discrete and continuous); the concept of Monte-Carlo methods and their applications. Software for solving some of the problems under consideration will also be demonstrated.

Course Objectives: Students should obtain knowledge about basic results and methods for studying various real objects, events, phenomena, etc. by using mathematical methods and computes.

Teaching Methods: lectures and tutorials

Requirements/Prerequisites: Numerical Analysis, Mathematical Optimization

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Course: by request at the end of the previous academic year

Registration for the Exam: coordinated with lecturer and Student Service Department

References:

1. E. S. Vencel – „Operations Research: Problems, Principles, Methodology“, 3-rd ed.,

Knorus, Moscow, 2014 (in Russian).
2. Yu. P. Zaichenko – “Operations Research”, Slovo, Kiev, 2003 (in Russian).
3. S. M. Stefanov – “Quantitative Methods of Management”, 2003 (in Bulgarian).
4. Additional Titles:
5. Hamdy A. Taha – „Operations Research. An Introduction”, 10-th ed., Pearson, USA, 2017.
6. S. M. Stefanov – “Separable Programming. Theory and Methods”, 4-th ed., Springer, Dordrecht–Boston–London, 2016.

PROTEINS AND ENZYMES

Semester: 1/3 semester

Course Type: lectures and tutorials

Hours per Week/FS/SS: 3 lecture hours and 1 lab hour per week/FS

ECTS Credits: 6 credits

Course Status: Compulsory Course in the Bioinformatics M.S. Curriculum

Course Description: The applied curriculum covers basic topics related to amino-acids, peptides, proteins and enzymes, with emphasis on three-dimensional protein structure and conformation. The course provides an overview of the basic concepts, principles and issues in this area. Proteins (including enzymes) will be studied at each structural level. Will be explained in detail the general modern experimental methods for studying proteins and their structure and address many practical examples.

Course Objectives: Students should gain detailed knowledge on the structure and function of proteins, study in detail and understand the basic capabilities of modern experimental approaches to structural analysis of proteins, learn about and to deal freely with the basic concepts in the study of proteins

Teaching Methods: lectures and tutorials Requirements/Prerequisites: Basic Biology and Chemistry

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Course: by request at the end of the previous academic year

Registration for the Exam: coordinated with lecturer and Student Service Department

References:

1. Оджакова, М. К., Биохимия. Унив. изд. Св. Климент Охридски, София, 2010.
2. Nelson D. L., Lehninger A. L., Cox M. M. Lehninger Principles of biochemistry. W. H. Freeman, 2008.
3. Gu J., Philip E. Bourne P. E., Structural Bioinformatics. John Willey & Sons, Inc. Second Edition, New Jersey, 2009.
4. Copeland R. A. Enzymes: a practical introduction to structure, mechanism, and data analysis. John Willey & Sons, Inc. New Jersey, 2004.

FUNDAMENTALS OF MOLECULAR BIOLOGY

Semester: 1/3 semester

Course Type: lectures and tutorials

Hours per Week/FS/SS: 2 lecture hours and 1 lab hour per week/FS

ECTS Credits: 4 credits

Course Status: Compulsory Course in the Bioinformatics M.S. Curriculum

Course Description: The enclosed curriculum deals with fundamental issues related to the knowledge of the structure of substances and organic compounds , the nature of chemical bonding , molecular quantum mechanics, bioenergy and more. As theoretical background for mathematical modeling and bioinformatics research.

It is built on two modules: - Structure of substances and - Construction of organisms at the molecular level.

In the first module to the matter of the theoretical chemistry related to the microscopic characteristics of the isolated molecule , such as nature of the chemical bond, the geometric configuration of the molecules , the distribution of electron density , valence nature of the weak intermolecular interaction , the energy spectrum of the molecules , etc. The second module includes theoretical foundations of the main organic compounds and biopolymers , and basic principles of metabolism , biochemical energy and some intracellular mechanisms of regulation.

The course will address the basic concepts and principles in these areas and will be illustrated their countries applied in molecular biology, crystallography , pharmacology , ligand design , drug design , and others.

Course Objectives: The course aims to equip students with basic knowledge and terminology of molecular biology and applied sides in mathematical modeling of the interactions between ligands and receptor structures of biological objects, their application in biology, chemistry, bioinformatics, etc. Each student must acquire concepts and skills to develop models of objects of different classes of compounds.

Teaching Methods: lectures and tutorials Requirements/Prerequisites: Basic Biology and Chemistry

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Course: by request at the end of the previous academic year

Registration for the Exam: coordinated with lecturer and Student Service Department

References:

1. Тютюлков Н. Строеж на молекулите, Университетско издателство „Св. Климент Охридски“, София, 2007.
2. Николов Т. Обща биохимия . Изд. Наука и изкуство, София, 1979..
3. Уотсън Д. ДНК. Тайните на живота. Инфо Дар. София, 2004.
4. Murray RK., Granner DK, Mayes P and Rodwell VW Harper’s Biochemistry, 25th edition, MC Graw Hill, 2000.
5. Баев В., АпостоловаЕ., Дскалова Ее., Минков Г. Ръководство по биоинформатика. Университетско издателство Паисий Хилендарский, том 10, 2013, първо електронно издание.

BIOINFORMATICS COMPUTER LAB

Semester: 2/4 semester

Course Type: lectures and tutorials

Hours per Week/FS/SS: 2 lecture hours per week/FS

ECTS Credits: 2 credits

Course Status: Optional Course in the Bioinformatics M.S. Curriculum

Course Description: The proposed course will address some softwares for analysis and assessment of bioinformatics products. The main objectives of the course is to equip students with practical skills and knowledge to work with specialized software programs.

The course will demonstrate approaches to undertake statistical analysis and ways of their solution. The models will be tested in practice.

Course Objectives: The goal of the studied subject is for students to gain knowledge and skills in the use of advanced statistical methods and approaches.

Teaching Methods: lectures and tutorials Requirements/Prerequisites: Basic Computer skills

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Course: by request at the end of the previous academic year

Registration for the Exam: coordinated with lecturer and Student Service Department

References:

1. Иван Тренчев. Въведение в Matlab. 2012. ЮЗУ Пресс.
2. Introduction in R language, 2013. http://www.r-project.org/
3. Garey M.R., Jonson D. S. Computational Complexity, 1994
4. Knuth D.E. Postscript about NP-hard Problems, SIGACT News, 1974.
5. Reingold E.M., Neivergelt J., Deo N. Combinatorial algorithms (Theory and Practice), 1980.

QUANTITATIVE PHARMACOLOGY

Semester: 2/4 semester
Course Type: lectures and tutorials
Hours per Week/FS/SS: 2 lecture hours per week/FS
ECTS Credits: 2 credits
Course Status: Compusory Course in the Bioinformatics M.S. Curriculum
Course Description: In the annexed curriculum deals with issues related to the theory of mathematical models in quantitative pharmacology. The course will address the basic concepts and principles in this area.
Mathematical modeling of drug-receptor interactions and its application in pharmacology will be explained. different approaches to banning models as graph theory operations research and others will be used.
With examples will further illustrate the application of mathematical models discussed in the field of drug design.
Course Objectives: The aim of the course is to familiarize students with the basic concepts and fundamental theoretical results in the theory of mathematical modeling of drug-receptor interactions and its application in drug design. Each student must acquire practical skills for preparing mat. Models in the field of quantitative pharmacology.
Teaching Methods: lectures and tutorials Requirements/Prerequisites: Basic Biology and Chemistry
Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Course: by request at the end of the previous academic year
Registration for the Exam: coordinated with lecturer and Student Service Department
References:

1. Talarida J. Jacobs. Jacobs L. The dose -response relationship in pharmacology. Springer - Verlag. New York 1979
2. Kenakin t. Pharmamacologic analysis of drug-receptor interaction. Reven Press, NewYork. 1987.
3. Norman Matloff. The Art of R Programming, 2011
4. Jim Albert. Bayesian Computation with R, Springer, 2009.

THEORETICAL MODELING IN GENOMICS

Semester: 2/4 semester

Course Type: lectures and tutorials

Hours per Week/FS/SS: 3 lecture hours and 1 lab hour per week/FS

ECTS Credits: 3 credits

Course Status: Optional Course in the Bioinformatics M.S. Curriculum

Course Description: In the annexed curriculum deals with issues related to the theory of mathematical models in quantitative pharmacology. The course will address the basic concepts and principles in this area.

Mathematical modeling of drug-receptor interactions and its application in pharmacology will be explained. different approaches to banning models as graph theory operations research and others will be used.

With examples will further illustrate the application of mathematical models discussed in the field of drug design.

Course Objectives: The goal of the studied subject is for students to gain knowledge and skills to solve real problems using modern methods and approaches.

Teaching Methods: lectures and tutorials Requirements/Prerequisites: Genetics

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Course: by request at the end of the previous academic year

Registration for the Exam: coordinated with lecturer and Student Service Department

References:

1. Dr Wybo J. Dondorp, The ‘thousand-dollar genome’ 2013г. USA, http://www.gezondheidsraad.nl/sites/default/files/201015E.pdf
2. Речник по биологични науки, McGraw-Hill, Наука и изкуство, София, 2002
3. Учебник Биология. Учебник за медицинските университети. Автори Ил. Ватев, В. Ишев, Дим. Ковачев, Цв. Маринова, Г. Николов, Сп. Станилова
4. CD “Картинен терминологичен речник по биоинформатика", автори: Ж.Винарова, П. Михова, ISBN 978-954-535-457-1, НБУ, София, 2007
5. Labor und Diagnose. Indikation und Bewertung von Laborbefunden fuer die medizinische Diagnostik. Thomas Lothar, DADE Behring, 5.th Ed. TH Books, Verlagsgeselloschaft mbH, Frankfurt / Main 1998
6. Аналитични принципи и процедури в клиничната лаборатория. Апарати за измерване, анализатори. Цветкова,Т., Ст.Данев (ред.), Пловдив, ИК-ВАП. 2001

ALGORITHMS IN BIOINFORMATICS

Semester: 2/4 semester

Course Type: lectures and tutorials

Hours per Week/FS/SS:2 lecture hours per week/FS

ECTS Credits: 3 credits

Course Status: Optional Course in the Bioinformatics M.S. Curriculum

Course Description: The course on "Algorithms in Bioinformatics" introduces students to the applications of discrete mathematics in bioinformatics. After reviewing the most important discrete structures, especially graphics, students will have knowledge of different algorithms for comparing sequences, probability calculations predict RNA structure (finding the most stable structure of RNA) and other optimization problems. The course covers algorithms regrouping of genomes that are mathematically and are important for genomics.

Course Objectives: The goal of the studied subject is for students to gain knowledge and skills for all important algorithmic and combinatorial concepts introduced in bioinformatics. By the end of the course, students will be able to read and understand research papers on methods in bioinformatics. Teaching Methods: lectures and tutorials Requirements/Prerequisites: Basic Biology

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Course: by request at the end of the previous academic year

Registration for the Exam: coordinated with lecturer and Student Service Department

References:

1. An Introduction To Bioinformatics Algorithms, Neil C. Jones, Pavel A. Pevzner(2008).
2. Introduction to algorithms in bioinformatics, Istvan Miklos, Renyi Institute (2010).
3. Algorithms in Bioinformatics: A Practical Introduction (Chapman & Hall/CRC Mathematical & Computational Biology) (2009).
4. Bioinformatics Algorithms: Techniques and Applications (2008).

SCRIPT LANGUAGES

Semester: 2/4 semester

Course Type: lectures and tutorials

Hours per Week/FS/SS: 2 lecture hours per week/FS

ECTS Credits: 2 credits

Course Status: Optional Course in the Bioinformatics M.S. Curriculum

Course Description: The proposed course consider scripting languages used in the solution of certain scientific problems. The main objectives of the course is to acquaint students with scripting languages programming. Students will gain practical skills and knowledge to work with specialized software programs.

The course will demonstrate the ability of some scripting languages for processing data received from from various scientific research. The models will be tested in practice. Examples of scripting languages are: R language, Matlab and others.

Course Objectives: The goal of the studied subject is for students to gain knowledge and skills in scripting languages, programming for data processing.

Teaching Methods: lectures and tutorials Requirements/Prerequisites: Basic Computer skills

Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

Registration for the Course: by request at the end of the previous academic year

Registration for the Exam: coordinated with lecturer and Student Service Department

References:

1. Norman Matloff. The Art of R Programming, 2011
2. Jim Albert. Bayesian Computation with R, Springer, 2009.
3. Phil Spector. Data Manipulation with R, 2008.
4. Brian S. Torvitt, Torsten Hothorn. A Handbook of Statistical Analyses 2006.
5. John Maindonald, John Braun. Data Analysis and Graphics Using R: An Example Based
6. Approach, Cambridge University Press, 2003.
7. John M. Chambers. Programming with Data, Springer, New York, 1998. This is also called the “Green Book”.

INTRODUCTION IN BIOPYTHON

Semester: 1/3 semester
Course Type: lectures and tutorials
Hours per Week/FS/SS: 3 lecture hours and 1 lab hour per week/FS
ECTS Credits: 6 credits
Course Status: Optional Course in the Bioinformatics M.S. Curriculum
Course Description: The proposed course will address some basic methods and approaches for the development of mathematical models and solving scientific problems. The main objectives of the course is to equip students with practical skills and knowledge of the different algorithms used in the design of scientific software. Students will acquire skills in searching for information in academic libraries.
The course will demonstrate approaches to development of mathematical models of real bioinforamtichni problems. Examples of approaches used in mathematical programming models: method of branches and limits Lagrange relaxations linear relaxation and more.
Course Objectives: The goal of the studied subject is for students to gain knowledge and skills for programming mathematical models using modern methods and approaches.
Teaching Methods: lectures and tutorials
Requirements/Prerequisites: Basic Computer skills
Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).
Registration for the Course: by request at the end of the previous academic year
Registration for the Exam: coordinated with lecturer and Student Service Department
References:

1. Cody Jackson. Learning to Program Using Python, 2011.
2. Knuth D.E. Postscript about NP-hard Problems, SIGACT News, 1974.
3. Reingold E.M., Neivergelt J., Deo N. Combinatorial algorithms (Theory and Practice), 1980.
4. Mark Lutz, O'Reilly Media. Python Pocket Reference, 4th Edition, 2009.

5. Dusty Phillips. Python 3 Object Oriented Programming, 2010

INTRODUCTION IN BIOJAVA

Semester: 1/3 semester
Course Type: lectures and tutorials
Hours per Week/FS/SS: 3 lecture hours and 1 lab hour per week/FS
ECTS Credits: 6 credits
Course Status: Optional Course in the Bioinformatics M.S. Curriculum
Course Description: In the annexed curriculum deals with issues related to the use of mathematical models in bioinformatics. The course will address the basic concepts and principles with the computer language Java.
Examples will be discussed to illustrates the application of mathematical models in the field of drug design and development of applications.
Course Objectives: The aim of the course is to familiarize students with the basic concepts and fundamental theoretical results in the theory of mathematical modeling of drug-receptor interactions and its application in drug design. Each student must acquire practical skills for preparing mat. Models in the field of quantitative pharmacology..
Teaching Methods: lectures and tutorials Requirements/Prerequisites: Basic Computer skills
Assessment: written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).
Registration for the Course: by request at the end of the previous academic year
Registration for the Exam: coordinated with lecturer and Student Service Department
References:

1. Увод в BioJava. http://biojava.org/wiki/Main_Page
2. Преслав Наков. Въведение в програмирането с Java. 2012, http://www.introprogramming.info /intro-java-book/read-online/
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