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***	
Functional Programming	4	Algorithms in Graphs and	6,5
Computer Programming and Data	5,5	Networks	7
Structures		Databases	7
Discrete Mathematics	5,5	Probability and Statistics	3
Computer Architectures	5	Practical Course in Computer	
Computer Networks and	5,5	Programming	2
Communications		Optional 1	4,5
Numerical Analysis and Mathematical	4,5	Optional 2	
Optimization			
		Optional Courses	
		Group 1:	
		Practical Course in Databases	
		Practical Course in Perl	
		Practical Course in Web Design	
		Practical Course in Combinatorics,	
		Coding Theory and Cryptography	
		Group 2:	
		Logical Programming	
		Software Engineering	
		Combinatorics, Coding Theory	
		and Cryptography	
	Total 30		Total 30
Second 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 5	2
Optional course 3	6	Optional course 6	2
Optional course 4	6	Preparation for a written state	15
		exam or thesis defense	
Optional courses			
Group 3:		***Optional courses***	
Introduction in Biopython		Group 5:	
Introduction in BIOJAVA		Computer molecular modeling	
Group 4:		Bioinformatics computer lab	
Operations Research		Group 6:	
Contemporary methods in computational		Quantitative Pharmacology	
biology		Script languages	
Statistical Analysis			
	Total 30		Total 30

FUNCTIONAL PROGRAMMING

Semester: 1 semester

Type of Course: Lectures and tutorials in computer lab

Hours per week - 2 hours lectures and 1 hour tutorials in computer lab

Credits Numbers: 4,0 credits

Course Status: Core course in curriculum of major Informatics, Bachelor degree. The course is introduction in design and programming in Scheme LISP dialect.

Objectives:

The student should obtain knowledge of:

- Design and programming in Scheme.
- Practical aspects of functional programming.

Methods of teaching: seminars, tutorials, discussions, project based method.

Pre-requirements: C++ programming and Data Structure

Assessment and Evaluation Quizzes - 30%, Final Test- 70%

The course is successful completed with at least 65% of all scores.

Registration for the Course: not required (core course)

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

References

1. Абелсън, Х., Дж. Сасмън Структура и интерпретация на компютърни програми. София, СОФТЕХ, 1994
2. Тодорова , М. Езици за функционално и логическо програмиране, първа част: функционално програмиране, София, СИЕЛА, 2004
3. Хендерсон, П. Функциональное програмирование: применение и реализация. Москва, Мир, 1983.

COMPUTER PROGRAMMING AND DATA STRUCTURES

Semester: 1-st semester

Type of Course: lectures, seminars and labs

Hours per week - 3 lectures + 1 seminars + 1 labs per week

Credits Numbers: 5,5

Course Status: Ffundamental course from the Computer Science MSc Curriculum (after BSc in another major field of study).

The course is providing basic knowledge in development of algorithms, using certain programming language, running and testing the programs under certain operation system. The structure and the main operational principles of the computer systems are given. The means and accuracy of information presentation are also considered. Some of the key classes of algorithms and data structures are studied. The main techniques of the structural approach of programming and their application using JAVA programming language are introduced. The aim of the course is to teach the students the techniques in development of algorithms and programs using JAVA

programming language. The knowledge will be used in the general theoretical, technical and some special courses.

Objectives:

Basic objectives and tasks:

- The students get knowledge of algorithm thinking;
- to give knowledge of the Data structures, that can process with computer;
- to give knowledge of the methods and skills in programming.
- to give knowledge of the syntax of a program language (JAVA);
- to give knowledge of the good style in programming;
- to give knowledge of the basic principles when develop applications

Methods of teaching: lectures, tutorials, group seminars or workshop, projects, other methods

Pre-requirements: Basic knowledge in Mathematics.

Exam: Written examination and discussion at the end of the semester, individual tasks and the general students' work during the semester.

Registration for the Course: not necessary

Registration for the Exam: Coordinated with the lecturer and the Student Service Office

References:

1. H. Schildt *Java 2 A Beginners Gide.* McGraw-Hill, 2001.
2. K.Arnold, J. Goslin, D. Holmes *The Java Programming Languag.* Sun
3. Microsystems,2000.
4. Саймън Харис, Джеймс Рос *Основи на алгоритмите.* Wiley, 2006.
5. Dori Smith *JAVA for Word Wide Web.* Peachpit Press, 1999.
6. H.Maruyama, K. Tamura, N. Uramoto *XML and JAVA: Developing Web*
7. *applications,* Addion-Wesley, 2001.
8. Иван Плачков *Ръководство по програмни езици.* УниСофт-Пловдив, 2000

DISCRETE MATHEMATICS

Semester: 1 semester

Course type: Lectures and tutorials

ECTS Credits: 5,5 credits

Course status: Compulsory Course in the Computer Science B.S. Curriculum

The Course is an Introduction in Discrete Structures used as a mathematical model in different computer science areas: logic, operations and relations in finite algebraic structures, representations of them as data structures, Boolean algebras, graphs, complexity of algorithms, combinatorics, finite automata etc.

Course aims: Non-trivial introduction in some important for Computer science areas, allowing the students to use effectively their knowledge in solving combinatorial problems.

Teaching methods: lectures, tutorials, group seminars or workshop, projects, other methods

Requirements/ Prerequisites: Basic knowledge in Mathematics.

Materials: Textbook and manual of the course are published, instructions for every laboratory

theme and exemplary programs; access to web sites via Internet.

Evaluation: Written examination and discussion at the end of the semester, individual tasks and the general student's work during the semester.

Registration for the course : not necessary

Registration for the exam: in the department office, co-ordinated with the lecturer.

References*:*

1. Денев, Й., С. Щраков, Дискретна математика, Благоевград, 1995
2. Павлов, Р., С. Радев, С. Щраков, Математически основи на информатиката, Благоевград, 1997
3. Денев, Й., Р. Павлов, Я. Деметрович, Дискретна математика, София, 1984
4. Фудзисава, Т. Касами. Математика для радиоинжинеров, Радио и связь, Москва, 1984
5. Чимев, Сл. Щраков. Математиката с информатиката, Благоевград, 1989
6. В. Яблонски. Въведение в дискретную математику, М. , 1979
7. В. Яблански, Г. П. Гаврилов, В. Б. Кудрявцев.Функции алгебри логики и классн Пост,М.,1966
8. Z.Manna. Mathematical theory of computation, McGraw-Hill Book Company, NY, 1974
9. J. Rayward-Smith. A first course in formal longuage theory, Bl. Sc. Publ., London, 1983. 10.Salomaa. Jewels of formal language theory, Comp. Sc. Press, Rockville, 1981

COMPUTER ARCHITECTURES

Semester: First semester

Form of the course: Lectures/exercises

Hours (per week): 3 hours lectures + 1 hours exercises per week, winter semester

Credits: 5 (five**)** credits

Status of the course in the educational plan:

The course is compulsory in the educational plan of MSc curriculum in Informatics.
Description of the course:

The course covers the advanced computer systems, their programming and functional model, introduce information in computer organization and memory types (major, operational, permanent, outdoor, etc.), system interruptions, features and technology solutions, conveyor ADP modes, system bus (types and structures), some problems of modern computer architectures (RISC, parallel and multiprocessor computer systems).

Scope of the course:

Obtaining knowledge of a systematic overview of the modern computer architecture, systems to form the theoretical and practical basis for better understanding of the work of computers to acquire skills in programming in assembly language.

Methods: discussions, practical exercises of the codes under consideration

Preliminary requirements: The students must have basic knowledge from mathematics.

Evaluation: permanent control during the semester (two written exams) and final exam.

Registration for the course: by application in the Educational Office

Registration for exam: up to agreement with the teacher and the Educational Office

References:

1. Брадли, Д. "Програмиране на асемблер за персонален компютър IBM/PC" Техника, София, 1989
2. Иванов Р. "Архитектура и системно програмиране за Pentium базирани компютри", Габрово, 1998.
3. J. L. Hennessy, D. A. Patterson. Computer Architecture: A Quantitative Approach (3rd ed.). Morgan Kaufmann Publishers, 1996.
4. Боровски Б., Боровска П., Архитектура на ЕИМ и микрокомпютри, Техника, 1992.
5. Горслайн Дж., Фамилия ИНТЕЛ, Техника, 1990.
6. Въчовски И., Наръчник по 32-разредни микропроцесори.
7. Компютърна енциклопедия, издателство Nisoft, част I и II.

COMPUTER NETWORKS AND COMMUNICATIONS

Semester: First semester

Form of the course: Lectures/exercises

Hours (per week): 3 hours lectures + 1 hours exercises per week, winter semester

Credits: 5,5 (five**)** credits

Course status in the curriculum: Compulsory for the students of speciality "Informatics" - bachelor degree .

Description of the course:
The course discuses the problems concerning design, building and application of computer networks. The lectures begin with introduction to computer networks, principles of building, historical development and their contemporary classification. Open system interconnection model of ISO is presented. Teaching course includes basic principles of building and functioning of Local Area Networks (LAN) illustrated by practical technical solutions in LAN Ethernet. The lectures on the most popular in the world computer network Internet present its basic characteristics, principles of functioning and application. The laboratory work helps to better rationalization of lecture material and contribute to formation of practical skills.

Aims and objectives of the course:
The aim of the course is to acquaint students with the basic principles, standards and tendencies of development in the field of computer networks. This will help them in future to professionally solve system tasks in the area of network communications.

Teaching methods:
Lectures (with slides, multimedia projector) and additional text materials; laboratory work (based on instructions) with a tutorial for every laboratory theme.

Prerequisites: Basic knowledge in informatics.

Auxiliary means for teaching:
Computer and multimedia projector for the course. Computer, development software, local area network, Internet and a tutorial for every laboratory theme.

Method of assessment: written examination (work for fixed time).

Arrangement for examination: in the department office, co-ordinated with the lecturer.

References*:*

1. Христов В. Киров Н.,“основи на компютърните мрежи и интернет”, ЮЗУ “Н.Рилски” - Благоевград, 2004
2. Ганчев И. Компютърни мрежи и комуникации. ИПМ - Пловдив, 1999.
3. Дод, А. Наръчник по телекомуникации. София, ИнфоДар, 1999
4. Костадинова А. и др. Съвременни системи за достъп до Интернет. Аналитичен обзор. Център за информация и документация - ЦЕНТИ, София, 2000.
5. Мирчев С. Т. АТМ комуникации. София, Нови знания, 2001
6. под редакцията на К. Боянов. Компютърни мрежи. Интернет, София, НБУ, 1999.

NUMERICAL ANALYSIS AND MATHEMATICAL OPTIMIZATION

Semester: 1 semester

Course Type: lectures

Hours per Week/FS/SS: 3 lecture hours per week/SS

ECTS Credits: 4.5 credits

Course Status: Compulsory Course in the Bioinformatics M.S. Curriculum, period of study 4 semesters.

Course Description: The course in Numerical Analysis and Mathematical Optimization includes basic results and methods in the area of Numerical Analysis and Mathematical Programming: part Numerical Analysis: basic methods for approximating functions – interpolation (Lagrange interpolating formula, interpolation error, divided differences, Newton from of interpolating polynomial) and least squares data fitting; numerical differentiation and numerical integration (Newton-Cotes quadrature formulas: midpoint rule and rectangular rule, trapezoidal rule, Simpson’s rule); basic methods for numerical solution of nonlinear equations (false position method, secant method, Newton-Raphson method); numerical methods for solving systems of linear equations (Gauss and Gauss-Jordan methods, method of LU decomposition, etc.); part Mathematical Optimization: theory and methods of Linear Programming (general and canonical form of the linear programming problem, graphical solution of two-dimensional linear programs, simplex method, the big M method, duality in linear programming); linear transportation problem (finding starting solution, method of potentials); matrix games (minimax theorem of John von Neumann, graphical solution of games 2 x 2, 2 x m, m x 2, relationship between matrix games and linear programming).

Course Objectives: Students should obtain knowledge about basic numerical methods and basic results and methods of linear programming.

Teaching Methods: lectures

Requirements/Prerequisites: Mathematical Analysis, Linear Algebra, Analytic Geometry

Assessment: written final exam

Registration for the Course: not necessary

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

References:

1. Bl. Sendov, V. Popov – “Numerical Analysis”, Part I, Kliment Ohridski Sofia University Press, Sofia, 1996 (in Bulgarian).

2. B. Boyanov – “Lectures on Numerical Analysis”, Darba Publishing House, Sofia, 1995 (in Bulgarian).
3. “Numerical Analysis Problem Book”, 2-nd ed., Kliment Ohridski Sofia University Press, Sofia, 1994 (in Bulgarian).
4. M. Kaschiev – “Numerical Analysis Handbook”, Martilen Publishing House, Sofia, 1994 (in Bulgarian).
5. Pasheva – “Introduction to Numerical Analysis”, Technical University, Sofia, 2009 (in Bulgarian).
6. S.M. Stefanov – “Quantitative Methods of Management”, 2003 (in Bulgarian).
7. R. L. Burden, J. D. Faires – “Numerical Analysis”, 9-th ed., Cengage Learning, Stamford, CT, USA, 2011.
8. J. D. Faires, R. L. Burden – “Numerical Methods”, 4-th ed., Brooks/Cole Publishing Company, Pacific Grove, CA, USA, 2013.
9. S.M. Stefanov – “Numerical Analysis”, MS4004-2203, Limerick, 1998.
10. Hamdy A. Taha – “Operations Research: An Introduction”, Prentice Hall, 10-th ed., 2017.

ALGORITHMS IN GRAPHS AND NETWORKS

Semester: 2 semester

Cours Tipe: Lectures and tutorials

Hours per week/FS/SS: 3 lecture hours, 1 tutorial hours per week/SS

ECTS credits: 6,5 credits

Course Status: Obligatory course in the Computer Science M.Sc. Curriculum.

Short Description:
The 1970s ushered in an exciting era of research and applications of networks and graphs in operations research, industrial engineering, and related disciplines. Graphs are met with everywhere under different names: "structures", "road maps" in civil engineering; "networks" in electrical engineering; "sociograms", "communication structures" and "organizational structures" in sociology and economics; "molecular structure" in chemistry; gas or electricity "distribution networks" and so on.

Because of its wide applicability, the study of graph theory has been expanding at a very rapid rate during recent years; a major factor in this growth being the development of large and fast computing machines. The direct and detailed representation of practical systems, such as distribution or telecommunication networks, leads to graphs of large size whose successful analysis depends as much on the existence of "good" algorithms as on the availability of fast computers. In view of this, the present course concentrates on the development and exposition of algorithms for the analysis of graphs, although frequent mention of application areas is made in order to keep the text as closely related to practical problem-solving as possible.

Although, in general, algorithmic efficiency is considered of prime importance, the present course is not meant to be a course of efficient algorithms. Often a method is discussed because of its close relation to (or derivation from) previously introduced concepts. The overriding consideration is to leave the student with as coherent a body of knowledge with regard to graph analysis algorithms, as possible.

In this course are considered some elements of the following main topics;

Introduction in graph theory (essential concepts and definitions, modeling with graphs and networks, data structures for networks and graphs, computational complexity, heuristics).

Tree algorithms (spanning tree algorithms, variations of the minimum spanning tree problem, branchings and arborescences).

Shortest-path algorithms (types of shortest-path problems and algorithms, shortest- paths from a single source, all shortest-path algorithms, the k- shortest-path algorithm, other shortest-paths).

Maximum- flow algorithms (flow-augmenting paths, maximum-flow algorithm, extensions and modifications, minimum-cost flow algorithms, dynamic flow algorithms).

Matching and assignment algorithms (introduction and examples, maximum- cardinality matching in a bipartite graph, maximum-cardinality matching in a general graph, maximum-weight matching in a bipartite graph, the assignment problem).

The chinest postman and related arc routing problems (Euler tours and Hamiltonian tours, the postman problem for undirected graphs, the postman problem for directed graphs).

The traveling salesman and related vertex routing problems (Hamiltonian tours, basic properties of the traveling salesman problem, lower bounds, optimal solution techniques, heuristic algorithms for the TSP).

Location problems (classifying location problems, center problems, median problems).

Project networks (constructing project networks, critical path method, generalized project networks).

Course Aims: Students should obtain basic knowledge and skills for solving optimization problems for graphs and networks.

Teaching Methods: lectures, tutorials, individual student's work

Requirements/Prerequisites: Linear Algebra, Linear optimization

Assessment: 3 homework D1,D2,D3; 2 tests K1, K2 (project); written final exam

Registration for the Course: by request at the end of the current semester (when is not obligatory course).

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

References:

1. Mirchev,Iv., "Graphs". "Optimization algorithms for networks", Blagoevgrad,2001 (in Bulgarian).
2. Mirchev,Iv., "Mathematical programming", Blagoevgrad, 2000 (in Bulgarian).
3. Minieka, E., "Optimization Algorithms for Networks and Graphs, Marcel dekker, Inc., New York and basel, 1978 /Майника, ^.АлгоритмьІ оптимизации на сетях и графах, М., "Мир" р1981/.
4. Christofides, N., Graph Theory. An Algorithmic Aproach, Academic Press lnc /London/ Ltd. 1975, 1997 /Кристофидес, Н. Теория графов. Алгоритмический подход, М., "Мир", 1978/.
5. Swami, M., Thulasirman, Graphs, Networks and Algorithms, John Wiley & Sons, 1981 /Сваами М., К. Тхуласирман. Графи, сети и алгоритми, М., "Мир", 1984/.

DATABASES

Semester: 2 semester

Course Type: lecture

Hours per week/FS/SS: 3 lecture; 2 exercise week/SS

ECTS credits: 7

Course Status: Obligatory course in the Computer Science In this course we will present Database Theory. Course contains programmer/analyst - oriented in database management, practical training.

Course Aims: Students should obtain knowledge and skills for designing of real database**;**

Teaching Methods: lectures, demonstrations and work on project

Requirements/Prerequisites: Linear algebra, Computer languages.

Assessment: course project

Registration for the Course: by request at the end of the current semester

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

References:

1. Pavel Azalov. Database. Relation and objective approach, Tehnika, 1991 г.
2. J .C. Shepherd, Database Management: Theory and application. 1990, Boston

PROBABILITY AND STATISTIC

Semester: 2 semester

Type of Course: lectures, **in** computer lab

Hours per week - 3 hours lectures, 2 hours tutorials in computer lab/winter se

Credits Numbers: 7 credits

Course Status: Obligatory course in curriculum of major Informatics. Bachelor degree. In this course questions of Probability and Mathematical Statistics are considered. Algorithms connected with finding structural and numerical characteristics of graph's are represented. Basic notion of Probability and Statistics are considered connected with Theory of Estimations, and Decision Theory in case of big and small samples, testing of hypothesis based on models about the probability distributions of the features in the investigated population.

Objectives: The students should obtain knowledge and understanding that the intercourse character needs to discover the connection Mathematics- Informatics- Physics- Economics and much more other sciences.

Methods of teaching: seminars, tutorials, discussions, project based method.

Pre- requirements: It is helpful the students have some knowledge in Analysis and Information Technology

Assessment and Evaluation: Three semestrials tests witch estimations will have part in the final estimation (50%). The course is successful completed with at least 65% of all scores.

Registration for the Course: obligatory course

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

References*:*

1. Байнов, Д., Теория на вероятностите и математическа статистика, Импулс-М, София, 1990.
2. Димитров, Б., Янев, Н., Вероятности и статистика, 1990, София.
3. Димитров, Б., Каращранова, Е. Статистика за нематематици, 1993, Благоевград
4. Б Фелър, У. Теория на вероятностите. "Наука и изкуство", София, 1985.

PRACTICAL COURSE IN COMPUTER PROGRAMMING

Semester: 2nd semester

Course Type: labs

Hours per week/SS: 2 labs hours per week/SS **ECTS credits**: 3.0 credits

Course Status: Compulsory Course in Master of Science Curriculum of Informatics

The course discusses the visual design environments and event-driven programming (Turbo C + + Builder, Visual Studio Express Edition, Turbo Delphi), through which can be created application software system. For example the development of software during the classes used programming language C++ (or C# or ObjectPascal). Students learn the principles of planning, design, development and testing of software and information systems.

Course Objectives:

The course aims to extend knowledge of programming with visual design environments and event-driven programming.

After completion of the course students should be able to:

- Give a specification to plan and design software;
- Develop software using a visual design environment and event-driven programming;
- Tested the final software product;
- Establish help support system and user guide.

Teaching Methods: Lectures, demonstrations, work on project and teamwork.

Requirements/Prerequisites: Needed basic knowledge of operating systems, information technology, object-oriented programming and databases. Desirable Knowledge of programming languages C + +, ObjectPascal and / or C #.

Assessment: Evaluating the student shall be carried out in the sixth grad scale. During the laboratory sessions the student receives n-assessments on current projects - CP1-CPn and protects the end of the semester individual course project - ICP. The final evaluation - FE is calculated according to: FE = ((CP1 + ... + CPn) / n + ICP) / 2

Registration for the Course: *By request at the end of the current semester*

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

References:

1. http://sharp.swu.bg:7651/rkraleva/LetenSem/PP/yprPP.htm
2. Hollingworth, J., Swart, B., Cashman, M., Gustavson, P. Borland C++ Builder 6 Developers Guide, SAMS, 2003
3. Borland Software Corporation. Borland C++ 6 for Windows Developers Guide. Borland Publishing 2002

PRACTICAL COURSE IN DATABASES

Semester: 2nd semester

Course Type: lab exercises

Hours per week/SS: 2 labs hours per week/SS

ECTS credits: 2.0 credits

Course Status: Optional Course in Master of Science Curriculum of Informatics

The course is practical introductions in Relational Database Management Systems (RDBMS). The students learns principles and methods for modeling data in relational database systems, and modeling applications for one-users account environment. Examine type of tasks in area of small office automations and stages on they realization. The course is naturally continuation on course of databases.

Course Objectives:
The course aims to extend knowledge of databases with visual design environments and event-driven programming.

After completion of the course students should be able to:

- modeled data in the context of database;
- apply a systematic approach to developing small software applications in the field of database;
- implement small projects of automation of office activities in the field of database.

Teaching Methods: Lectures, demonstrations, work on project and teamwork.

Requirements/Prerequisites: Needed basic knowledge of information technology, databases, object-oriented programming and work with MS Access. Desirable Knowledge of programming languages C + +, ObjectPascal and / or C #.

Assessment: Evaluating the student shall be carried out in the sixth grad scale. During the laboratory sessions the student receives n-assessments on current projects - CP1-CPn and protects the end of the semester individual course project - ICP. The final evaluation - FE is calculated according to: FE = ((CP1 + ... + CPn) / n + ICP) / 2

Registration for the Course: Submitted an application to the academic department at the end of current semester.

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

References:

1. Churcher, C. Beginning Database Design: From Novice to Professional. Paperback, 2007
2. Peter Rob, Carlos Coronel. Database Systems: Design, Implementation, and Management. Hardcover, 2007
3. Rod Stephens. Beginning Database Design Solutions (Wrox Programmer to Programmer). Paperback, 2008
4. Borland Software Corporation. Borland Developer Studio 2010. Borland Publishing 2010

PRACTICAL COURSE IN PERL

Semester: 2nd semester

Course Type: labs

Hours (weekly)/WS/SS: 2 labs per week/SS

ECTS Credits: **2.0** credits

Short Description:
This course observes Perl language and it application in different aspects of software development and data processing.

Course Aims:
The course aim is to give theoretical and practical background to students to use script languages in software development.

Teaching Methods: Labs.

Requirements/Prerequisites: Knowledge in Operating Systems, Programming Basics, Discrete Mathematics.

Exam: final exam

Registration for the course: A request is made by students at the end of the current semester

Registration for the exam: Coordinated with lecturer and Students Service Department

References:

1. http://idamianov.web.officelive.com/
2. David Till, Teach Yourself Perl 5 in 21 day
3. http://www.perl.org
4. http://docs.rinet.ru/Perl5_examples/
5. http://docs.rinet.ru/PerlSBlohami/
6. http://docs.rinet.ru/Using_Perl5_in_Web/

PRACTICAL COURSE IN WEB DESIGN

Semester: 2nd semester

Course Type: lab exercises

Hours per week/SS: 2 labs hours per week/SS

ECTS credits: 2.0 credits

Course Status: Optional Course in Master of Science Curriculum of Informatics

The proposed curriculum dealing with issues and techniques in the field of Web design. Techniques are presented concerning the construction of static and dynamic pages and bringing them into full sites. Deals with the current software to develop web sites and also language HTML, DHTML and CSS. The course is the basis for the courses "Programming in Internet" and "Internet technologies".

Course Objectives:
The course is for students to gain a comprehensive picture of the structure and language capabilities of HTML, DHTML and CSS.

After completion of the course students should be able to:

- use language HTML, DHTML, CSS, and through them to create Web sites;
- knowledge of current development environments for the Web.

Teaching Methods: Lectures, demonstrations, work on project and teamwork.

Requirements/Prerequisites: Needed basic knowledge of information technology. Desirable Knowledge of programming languages C + +, ObjectPascal and / or C #.

Assessment: Evaluating the student shall be carried out in the sixth grad scale. During the laboratory sessions the student receives n-assessments on current projects - CP1-CPn and protects the end of the semester individual course project - ICP. The final evaluation - FE is calculated according to: FE = ((CP1 + ... + CPn) / n + ICP) / 2

Registration for the Course: Submitted an application to the academic department at the end of current semester.

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

References:

1. Jennifer Niederst Robbins and Aaron Gustafson. Learning Web Design: A Beginner's Guide to (X)HTML, StyleSheets, and Web Graphics. Paperback, 2007
2. Patrick McNeil. The Web Designer's Idea Book: The Ultimate Guide To Themes, Trends & Styles In Website Design. Paperback, 2008
3. Ethan Watrall and Jeff Siarto. Head First Web Design. Paperback, 2008

PRACTICAL COURSE IN COMBINATORICS, CODING THEORY AND CRYPTOGRAPHY

Semester: Second semester

Form of the course: Exercises

Hours (per week): 2 hours exercises per week, summer semester

Credits: 2 (two) credits

Status of the course in the educational plan: The course is optional in the MSc curriculum in Informatics.

Description of the course:
The Practical course is scheduled to be held simultaneously with the course of Combinatorics, Coding Theory and Cryptography (CCC), which introduced the basic concepts of coding theory, error-correcting codes, Hamming distance, code parameters, equivalency of codes, and encoding and decoding with linear codes, syndrome decoding, cyclic codes. In the cryptographic part, the classical chiphers are considered and followed by the modern systems for secret and public keys.

Scope of the course:
The aim of the course is students to acquire practical skills for working with linear codes over finite field, perfect codes, Hamming codes, and practical applications of coding theory and cryptography.

Methods: discussions, practical exercises on the codes under consideration

Preliminary requirements: The students must have basic knowledge from the Number theory and algebra, probability theory, coding theory and cryptography

Evaluation: permanent control during the semester (two written exams) and exam - coursework problem

Registration for the course: by application in the Educational Office

Registration for exam: up to agreement with the teacher and the Educational Office

Literature:

1. R. Hill. A first course in coding theory, Calderon Press, Oxford, 1986.
2. F. J. MacWilliams, N. J. A. Sloane, The theory of error-correcting codes, New York, North Holland, 1977 (руски превод Москва, Свьязр 1979).
3. W. Peterson, E. Weldon Jr., Error-correcting codes, Second edition, Cambridge (Mass), MIT Press, 1971 (руски превод Москва, Мир, 1976).
4. Р. Блейхут. Теория и практика кодов, контролирующих ошибки, Москва, Мир,
5. 1986.
6. Записки (www.moi.math.bas.bg/~peter).

LOGIC PROGRAMMING

Semester: 2 semester

Type of Course: lectures and labs

Hours per week - 2 lectures + 1 seminar per week

Credits Numbers: 4,5

Course Status: Optional course from the Computer Science Bachelor Curriculum.

The course provides introduction to logic programming. The main techniques of the structural approach of programming and their application using Prolog programming language are introduced.

Objectives:
The aim of the course is to teach the students with the techniques in development of algorithms and programmes using Prolog programming language. The knowledge will be used in the general theoretical, and some special courses for example programming for artificial intelligence

Methods of teaching: lectures and labs in a computer classroom

Pre-requirements: Basic knowledge in "Programming and Data structures" and “Mathematical Logics”.

Exam: Written examination and discussion at the end of the semester, individual programming task and the general student’s work during the semester.

Registration for the Course: not necessary

Registration for the Exam: Coordinated with the lecturer and the Student Service Office
References:

1. М. Тодорова Езици за функционално и логическо програмиране, втора част Логическо програмиране. София, Сиела, 2003.
2. И. Держански, И. Ненова “Пролог за лингвисти.” Tempus S-JEP-07272-94, 1997.
3. W. F. Clocksin, C. S. Mellish “Programming in Prolog” Springer-Verlag, 1984.
4. Bratko “Prolog Programming for Artificial Intilligence. Addison-Wesley,1986.
5. G. Metakides, A. Nerode “Principles of Logic and Logic Programming” Elsever, 1996.
6. John Malpas “Prolog: A Relational Language and its Application.Prentis-Hall,1987.
7. Thayse, P. Gribomont, G. Louis, D. Snyers, P. Wodon, P. Goshet, E. Gregoire, E. Sanchez, Ph. Delsarte “Approshe Logique de L’Intelligence Artificielle. Paris, Bordas, 1988.

8. J. Doores, A. R. Reiblein, S. Vadera “Prolog - programming for tomorrow” Sigma Press, 1987.

SOFTWARE ENGINEERING

Semester: 2 semester

Type of Course: lectures and tutorials in computer lab

Hours per week: 2 hours lecture and 1 hour tutorials in computer lab

Credits Numbers: 4,5 credits

Course Status: Elective course in curriculum of major Informatics. Master degree.

Fundamental software engineering techniques and methodologies commonly used during software development are studied. Topics include various life cycle models, project planning and estimation, requirements analysis, program design, construction, testing, maintenance and implementation, software measurement, and software quality. Emphasized are structured and object-oriented analysis and design techniques, use of process and data models, modular principles of software design, and a systematic approach to testing and debugging. The importance of problem specification, programming style, periodic reviews, documentation, thorough testing, and ease of maintenance are covered.

Objectives:

- Analyze software development, define the key principles and techniques of software engineering and software project management.
- Identify the main bottlenecks and difficulties in the software process, and the available methods for mitigating them.
- Recognize challenges and opportunities associated with rapid technological advances in the field of software development.

Methods of teaching: lectures, tutorials, discussions, project based method.

Pre - requirements: No (core course)

Assessment and Evaluation

Project - 40%

Final Test - 60%

The course is successful completed with at least 65% of all scores.

Registration for the Course: No (core course)

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

1. Ескенази А., Н. Манева, Софтуерни технологии, II-ро преработено и допълнено издание, КЛМН, София 2006
2. Греъм Къртис, *Бизнес информационни системи,* София 1995.

COMBINATORICS, CODING THEORY, CRYPTOGRAPHY

Semester: Second semester

Form of the course: Lectures/exercises

Hours (per week): 3 hours lectures per week, summer semester

Credits: 4,5 credits

Status of the course in the educational plan:
The course is to be chosen in the educational plan of specialties Informatics, MSc after BSc in field different from Informatics.

Description of the course:
The course starts with introduction of the main notions of the Coding theory - error- correcting codes, Hamming distance, code parameters, equivalency of codes. Then the necessary algebraic background (finite fields and vector spaces over finite fields) is developed and encoding and decoding with linear codes (including syndrome decoding) are studied. Important classes of codes are introduced and the theory of cyclic codes is developed. In the cryptographic part the classical chiphers are considered and followed by the modern systems for secret and public keys.

Scope of the course:
Obtaining knowledge of the theoretical backgrounds and practical abilities for applications of the Coding theory and the cryptography. Development of abilities for work with (linear) codes over finite field with special emphasis of their algebraic and combinatorial properties.

Methods: lectures, discussions, practical exercises of the codes under consideration

Preliminary requirements: The students must have basic knowledge from the Number theory and algebra.

Evaluation: permanent control during the semester (two written exams) and exam in the semester's end in two parts - problems solving and answering theoretical questions.

Registration for the course: by application in the Educational Office in the end of the semester

Registration for exam: up to agreement with the teacher and the Educational Office

References:

1. Notices (www.moi.math.bas.bg/~peter)
2. Raymond Hill. A First Course in Coding Theory, Calderon Press, Oxford, 1986.

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
3. 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
4. Baxter M.J., Beardah C.C.,MATLAB Routines for Kernel Density Estimation and the Graphical Representation of Archaeological Data Department of Mathematics,
5. Statistics and Operational Research, The Nottingham Trent University, 2010, http://science.ntu.ac.uk/msor/ccb/caarev.ps
6. Boething R.S., Mackay D. (editors), Handbook of Property Estimation Methods for Chemicals. Environmental and Health Sciences, Lews Publishers, 2000
7. 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' 2013r. 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: 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, period of study 4 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. Hamdy A. Taha – „Operations Research. An Introduction", 10-th ed., Pearson, USA, 2017.
5. 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. Прееслав Наков. Въведение в програмирането с Java. 2012, http://www.introprogramming.info /intro-java-book/read-online/
3. Talarida J. Jacobs. Jacobs L. The dose -response relationship in pharmacology. Springer - Verlag. New York 1979
4. Jose Maria Lagaron, Antimicrobial Polymers, 0470598220, Publisher : Wiley, 2013
5. Approved drug products with therapeutic equivalence evaluations, u.s. department of health and human services, 2013