QUALIFICATION CHARACTERIZATION[1]
OF MAJOR FIELD OF STUDY "MATHEMATICS"
FOR "BACHELOR OF SCIENCE" DEGREE
WITH PROFESSIONAL QUALIFICATION "MATHEMATICIAN"

South-West University "Neofit Rilski" prepares qualified experts in Mathematics that can apply their knowledge and skills in the area of science, culture, education and economics in Bulgaria and abroad.

Major field of study "Mathematics" by the compulsory subjects included in the curriculum provides fundamental widespread knowledge of mathematics and by the optional subjects in-depth knowledge in selected students mathematical area or field of informatics, economics, ecology, business, law and etc. Graduates have basic knowledge in mathematical areas: algebra, geometry, calculus, complex analysis, differential equations, probability and statistics, numerical methods, mathematical optimization, analytical mechanics, discrete mathematics, object-oriented programming, data structures and algorithms and information technology. Students graduated in "Mathematics" have profound theoretical knowledge and skills to solve mathematical problems, as well as programming skills. In the learning process, they acquire skills and knowledge to independently search for information in the literature and the Internet, multimedia presentations of various projects, as well as proficiency in English.

After completion of Bachelor of Science (BSc) degree in Mathematics, students obtain opportunity for successful continuation of education in higher degrees (Master of Science and PhD) in Bulgaria and abroad.

Students completed BSc degree in Mathematics have to possess following knowledge, skills and competences:

- profound knowledge of basic concepts, principles, theories and results in different areas of mathematics;
- depth knowledge in the "elementary" mathematics (studied in high school);
- knowledge of specific programming languages and software;
- knowledge of English and Information Technology.

[1] *Qualification characterization of Major field of study "Mathematics" for BSc degree is a basic document that determines rules for developing the curriculum. This qualification characterization is conformed to legislation in the area of higher education in Republic of Bulgaria.*

CURRICULUM

Field of Study: Mathematics

First Year			
First Semester	**ECTS credits**	**Second Semester**	**ECTS credits**
Compulsory Courses		***Compulsory Courses***	
Introduction to mathematics	3.0	Mathematical analysis 2	9.0
Linear algebra	6.0	Higher algebra 1	9.0
Analytic geometry	6.0	Mathematical logic	6.0
Mathematical analysis 1	6.0	Practical course in mathematical analysis	3.0
Practical course in linear algebra and analytic geometry	2.0	English 2	3.0
		Sport	
Introduction to computer programming	5.0		
English 1	2.0		
	Total 30		**Total 30**
Second Year			
First Semester	**ECTS credits**	**Second Semester**	**ECTS credits**
Compulsory Courses		***Compulsory Courses***	
Mathematical analysis 3	7.0	Discrete mathematics	5.5
Ordinary differential equations	7.0	Mathematical optimization	7.0
Higher algebra 2	6.0	Complex analysis	6.0
Number theory	6.0	Partial differential equations	7.0
Introduction to information systems and technologies	4.0	Optional course 1	4.5
		Sport	
		Optional Courses (course 1)	***4.5***
		Semigroup theory	4.5
		Representation theory of groups	4.5
		Introduction to LATEX	4.5
		Introduction to coding theory	4.5
	Total 30		**Total 30**
Third Year			
First Semester	**ECTS credits**	**Second Semester**	**ECTS credits**
Compulsory Courses		***Compulsory Courses***	
Numerical analysis I	7.5	Theory of probability and statistics I	8.0
Differential geometry	7.5	STEM educational technologies in science,	5.5
Graph theory	6.0	mathematics and informatics education	
Optional course 2	4.5	Numerical analysis 2	8.0
Optional course 2	4.5	Practical course in differential equations	4.0
		Optional course 3	4.5
Optional Courses (course 2)	***4.5***	Sport	
Mathematical structures	4.5		
Symmetric semigroups	4.5	***Optional Courses*** (course 3)	***4.5***
Extremum problems in high school course of mathematics	4.5	Practical course in mathematical modeling with Matlab	4.5
Fundamentals of modeling	4.5	Numerical methods Monte Carlo	4.5
Mathematical models in economics	4.5	Special matrices	4.5
History of mathematics	4.5	Mathematical models in biology and medicine	4.5
Functional equations in extracurricular work in mathematics	4.5		
	Total 30		**Total 30**

Fourth Year			
First Semester	**ECTS credits**	**Second Semester**	**ECTS credits**
Compulsory Courses		***Compulsory Course***	
Specialized statistical software	6.0	Constructive theory of functions	5.0
Operations research	7.5	Theory of probability and statistics 2	6.0
Fundamentals of geometry	6.0	Optional course 5	4.5
Fundamentals of arithmetic	6.0	Optional course 5	4.5
Optional course 4	4.5	Graduation	10.0
Sport			
		Optional Courses (course 5)	***4.5***
Optional Courses (course 4)	***4.5***	Multivalued functions and differential	4.5
Specialized mathematics software	4.5	inclusions	
Specific STEM educational	4.5	Uniform distribution of sequences	4.5
technologies in mathematics		Introduction to cryptography	4.5
education		Generating functions	4.5
Numerical methods for extremal	4.5	Combinatorial ring theory	4.5
problems		Project management	4.5
Decision making algorithms in	4.5		
management and economics			
	Total 30		**Total 30**
TOTAL FOR 4 ACADEMIC YEARS: 240 CREDITS			

COURSES DESCRIPTION

COMPULSORY COURSES

INTRODUCTION TO MATHEMATICS

Semester: 1 semester
Course Type: Lectures/ exercises
Hours per week: 1 hour lectures + 2 hours exercises per week/SS
Credits: 3.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilsky" – Blagoevgrad
Status of the course in the education program: Optional course in B. S. Curriculum of Mathematics
Description of the course: The introductory mathematics course is a review, of course, with some expansion, of the algebra and geometry studied by students in secondary school. The aim of the course is to standardize the knowledge of the students in relation to their knowledge from the school mathematics course. On the other hand, this course will represent a transition from elementary to higher mathematics. All the main topics of algebra and geometry will be presented with some expansion.
Aims of the course: The students obtain knowledge and skills in the already mentioned themes and learn how to use them in their future educational practice.
Methods: lectures, exercises discussions, partial exercises.
Preliminary requirements: The students must have basic knowledge from school courses in mathematics
Evaluation: permanent control during the semester (two written exams) an exam at the semester's end in two parts-problems solving and answering theoretical questions**.**
Registration for the course: The course is obligatory.
Registration for exam: up to agreement with the teacher and the Educational Office

References

1. B. Petkanchin, The foundations of Mathematics, Science and Art, Sofia, 1963.
2. L. Davidov, S. Dodunekov, Elementary algebra and elementary functions, Narodna Prosveta, 1984.
3. P. Radnev, The foundations of the school course of algebra and analysis, Plovdiv University, Plovdiv, 1985.
4. R. Roussev, V. Georgiev, Guidance for solving mathematics problems for applicants for university, Science and Art, Sofia, 1973.

Abbreviation:
SS: Spring semester
FS: Fall Semester

LINEAR ALGEBRA

Semester: 1 semester
Course Type: Lectures and tutorials
Hours per week: 3 lecture hours and 2 tutorial hours / FS
ECTS credits: 6.0 credits

Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Short Description: The education of that discipline includes some of the basic notations in combinatory and complex numbers. Students study matrices, determinants, systems linear equations and methods for their solving, linear spaces, linear transformations and operations with them, orthogonal and symmetric matrices and transformations, quadratic forms and their canonization.
Course Aims: The students have to obtain knowledge and skills to apply the learned theory for modeling and solving real practical tasks, to do basic operations with matrices, to solving determinants and systems linear equations using the methods of Gauss and Kramer, to be able to distinguish the correspondence between algebraic objects, to determine their characteristics and to transfer them on others – difficult to examine.
Teaching Methods: lectures, tutorials, homework, and problem solving tests.
Requirements/Prerequisites: The students should have basics knowledge from school mathematics.
Assessment: permanent control during the semester including homework and two written exams, and written exam in the semester's end on topics from tutorials and on topics from lectures.
Registration for the exam: coordinated with the lecturer and student Service Department

References

Basic Titles

1. A. Borisov, Il. Guidzhenov, Il. Dimitrova. "Linear Algebra". University Press, South-West University "Neofit Rilski", Blagoevgrad, 2009 /in Bulgarian/.
2. A. Borisov. M. Kacarska. "Handbook on Linear Algebra and Analytic geometry". University Press, South-West University "Neofit Rilski", Blagoevgrad, 2011 /in Bulgarian/.
3. K. Yordzhev, Il. Dimitrova, A. Markovska, Il. Gyudzhenov. Variants for Examinations on Linear Algebra and Analytic Geometry, University Press, South-West University "Neofit Rilski", Blagoevgrad, 2007 /in Bulgarian/.
4. K. Denecke, K. Todorov. "Lectures on Linear Algebra". University Press, South-West University "Neofit Rilski", Blagoevgrad, 1992 /in Bulgarian and German/.
5. M. Aslanski, B. Giurov. "Handbook on Linear Algebra". University Press, South-West University "Neofit Rilski", Blagoevgrad, 1999 /in Bulgarian/.
6. K. Dochev, D. Dimitrov. "Linear Algebra". Sofia, 1977 /in Bulgarian/.
7. D. Dimitrov. "Collections of Problems on Linear Algebra". Sofia, 1978 /in Bulgarian/.
8. A. Kurosh. "Course on Algebra". Sofia, "Nauka i izkustvo", 1967 /in Bulgarian and Russian/
9. V. P. Dyakonov, MATLAB, DMK Press, Moscow, 2012.
10. B. Hunt, R. Lipsman, J. Rosenberg, K. Coombes, A Guide to MATLAB® for Beginners and Experienced Users Second Edition, Cambridge University Press, 2006.

Additional Titles

1. D. K. Fadeev, I. S. Sominski. "Handbook on Algebra". Moscow, "Nauka", 1968 /in Russian/
2. I. V. Proskuriakov. "Handbook on Linear Algebra". Moscow, "Nauka", 1967 /in Russian/.
3. V. A. Ilin, E. G. Pozniak. "Linear Algebra". Moscow, "Nauka", 1984 /in Russian/.
4. M. Nikolova, Helping materials for Matlab, http://ns.naval-acad.bg/MNikolova/uchebni.htm, 2014.
5. J. Attia, Electronics and circuit analysis using MATLAB, CRC Press, 1999.

Abbreviation:
FS: Fall Semester

SS: Spring Semester

ANALYTIC GEOMETRY

Semester: 1 semester
Course Type: Lectures and tutorials
Hours per week: 3 lecture hours and 2 tutorial hours /FS
ECTS credits: 6.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Short Description: The education of that discipline includes learning of vector calculus, affine coordinate systems and analytic representations of straight lines and planes. After introducing the cross ratio, the projective coordinate systems are used as well. The basic elements of the projective, of the affine and of the metric theory of the curves and the surfaces of the second degree are taught.
Course Aims: The students have to obtain knowledge and skills for application of the analytic apparatus for research of geometric objects.
Teaching Methods: lectures, tutorials, homework, problem solving tests.
Requirements/Prerequisites: Linear Algebra and Mathematical Analysis
Assessment: permanent control during the semester including homework and two written exams, and written exam in the semester's end on topics from tutorials and on topics from lectures.
Registration for the exam: coordinated with the lecturer and student Service Department

References

Basic Titles

1. A. Borisov. "Lectures on Analytic geometry". University Press, South-West University "Neofit Rilski", Blagoevgrad, 2000 /in Bulgarian/.
2. A. Borisov. "Handbook on Analytic geometry". University Press, South-West University "Neofit Rilski", Blagoevgrad, 2011 /in Bulgarian/.
3. Borisov, A., I. Dimitrova. Examination versions of problems in Analytic geometry. University Press, South-West University "Neofit Rilski", Blagoevgrad, 2012 /in Bulgarian/.
4. G. Stanilov. "Analytic geometry". Sofia, 2000 /in Bulgarian/.

Additional Titles

1. A. Borisov. "Analytic geometry". University Press, South-West University "Neofit Rilski", Blagoevgrad, 1993 /in Bulgarian/.
2. A. Gjonov, N. Stoev. "Handbook on Analytic geometry". Sofia, 1988 /in Bulgarian/.
3. N. Martinov . "Analytic geometry". Sofia, 1989 /in Bulgarian/.
4. B. Petkanchin. "Analytic geometry". Sofia, 1961 /in Bulgarian/.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

MATHEMATICAL ANALYSIS 1

Semester: 1 semester
Course Type: lectures and seminars
Hours per Week: 3 lecture hours and 3 seminars hour / FS
ECTS Credits: 6.0 credits

Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Compulsory course in Mathematics B.C. Curriculum.
Short Description: The main topics to be considered:

- Numerical sequences
- Numerical series
- Limit, continuity and differentiability of functions
- Integrals of functions of real variables
- Applications of the integral calculation

Course Aims: This course develops in details the problems of numerical sequences, numerical series, differential and integral calculation of functions of one real variable.
Teaching Methods: Lectures, tutorials, homework, problem-solving tests. During the lectures students are acquainted with the basic theoretical material – definitions, theorems, applications, with the methods of theorems proofs. During seminars students solve practical problems. The knowledge obtained within the theoretical practice is used and it is also used in the process of problem solving.
Requirements/Prerequisites: Basic knowledge of courses in Elementary Mathematics, Linear Algebra, Analytical Geometry is necessary.
Assessment: permanent control during the semester including homework and two written exams, and written exam in the semester's end on topics from tutorials and on topics from lectures.
Registration for the exam: coordinated with the lecturer and student Service Department

References

Basic Titles

1. V. A. Ilin, V. A. Sadovnichi, B. H. Sendov, Mathematical Analysis, Vol. 1 and 2, Sofia, Science and Art, 1989.
2. V. Grozdanov, Mathematical analysis, first part, University Publishing House "Neofit Rilsky", Blagoevgrad, 2014.
3. V. Grozdanov, K. Iordjev, A. Markovska, Handbook of mathematical analysis, University Publishing House "Neofit Rilsky", Blagoevgrad, 2013.
4. Ia. Tagamlitzky, Differential Calculation, Sofia, Science and Art, 1971.
5. Ia. Tagamlitzky, Integral Calculation, Sofia, Science and Art, 1971.
6. I. Prodanov, N. Hadjivanov, I. Chobanov, Collection of problems of Differential and Integral Calculation, Sofia, Science and Art, 1976.

Additional Titles

1. S. M. Nikol'skii, Course of Mathematical Analysis, Vol. 1 and 2, Moscow, Science, 1973.
2. L. D. Kudrjavcev, Mathematical Analysis, Vol. 1 and 2, Moscow, Science, 1976.

PRACTICAL COURSE IN LINEAR ALGEBRA AND ANALYTIC GEOMETRY

Semester: 1 semester
Course Type: Tutorials
Hours per week /FS/SS: 2 tutorial hours /FS
ECTS credits: 2.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad

Course Status: Compulsory course in the B.S. Curriculum of „Mathematics".
Short Description: The education of that discipline includes some of the basic notations in Linear Algebra and Analytic Geometry, and the included topics are analyzed and implemented with the help of basic software.
Course Aims: The purpose of this course is to introduce students with the opportunity to use modern methods and tools for solving problems of Linear Algebra and Analyticl Geometry.
Teaching Methods: tutorials, homework and tests.
Requirements/Prerequisites: The students should have basic knowledge in Linear Algebra and Analytic Geometry.
Assessment: permanent control during the semester including two homework and two tests, or exam at the semester's end.
Registration for the exam: coordinated with the lecturer and student Service Department

References

Basic Titles

1. A. Borisov, Il. Guidzhenov, Il. Dimitrova. "Linear Algebra". University Press, South-West University "Neofit Rilski", Blagoevgrad, 2009 /in Bulgarian/.
2. A. Borisov. M. Kacarska. "Handbook on Linear Algebra and Analytic geometry". University Press, South-West University "Neofit Rilski", Blagoevgrad, 2011 /in Bulgarian/.
3. V. P. Dyankov, MATLAB, DMK Press, Moscow, 2012 /in Russian/.
4. D. Houcque, Introduction to Matlab for Engineering Students, Northwestern University, 2005.
5. B. Hunt, R. Lipsman, J. Rosenberg, K. Coombes, A Guide to MATLAB® for Beginners and Experienced Users Second Edition, Cambridge University Press, 2006.
6. MathWorks, MATLAB Programming Fundamentals, 2021
7. Phelps Steve, An Introduction to GeoGebra, University of Cincinnati (free online)
8. http://www.geogebra.org
9. https://www.mathworks.com/

Additional Titles

1. V. A. Ilin, E. G. Pozniak. "Linear Algebra". Moscow, "Nauka", 1984 /in Russian/.
2. M. Nikolova, Matlab Materials, http://ns.naval- acad.bg/MNikolova/uchebni.htm, 2014.
3. I. V. Proskuriakov. "Handbook on Linear Algebra". Moscow, "Nauka", 1967 /in Russian/.
4. J. Attia, Electronics and circuit analysis using MATLAB, CRC Press, 1999.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

INTRODUCTION TO COMPUTER PROGRAMMING

Semester: 1 semester
Type of Course: lectures and tutorials in computer lab
Hours per week: 2 lecture hours and 2 tutorial hours in computer lab/ FS
ECTS Credits: 5.0 credits
Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Compulsory course in Mathematics B.C. Curriculum.
Course description: The course is an introduction to computer programming. Topics data representation in computer, algorithms, data types, variables, expressions, arrays, procedures,

functions, as well as object-oriented programming and event-driven programming paradigm are covered. The course assumes no or little prior knowledge of programming.
Objectives: The main goal of the course is the students to master principles of programming and algorithms.
Methods of teaching: lectures, tutorials, discussions, problem passed method, Project based method.
Pre-requirements: No need.
Assessment and Evaluation: Practical work and test- 50%, Final Exam 50%. **The course is successful completed with at least 65% of all scores.**
Registration for the Exam: coordinated with the lecturer and the Student Service Office

References

1. D. Schneider, An Introduction to Programming Using Visual Basic Int. Ed., Prentice Hall, Pearson Education Inc., 9th Ed 2014, (8th Ed 2010).
2. D. Zak, Programming with Microsoft Visual Basic 2012, Course Technology, Cengage Learning, 6th Ed. 2014.
3. URL http://dlearning.swu.bg

ENGLISH 1

Semester: 1 semester
Course type: Seminars
Hours per week: 2 hours per week /FS
ECTS credits: 2.0 credits
Department: Faculty of Phylology, SWU "Neofit Rilski" – Blagoevgrad
Course Status: Compulsory course in Mathematics B.C. Curriculum.
Course description: The course focuses on updating basic communication skills in accordance with the rules of the English language. At the end of the course, students must have an active set of words and phrases corresponding to the language skills for levels A1 and A2, according to the Common European Framework of Reference for Languages. They must be able to read, listen to and understand texts in English, as well as to create texts for different purposes and be able to express themselves in English.
Course Aims:
- knowledge of grammar rules;
- basic lexical knowledge;
- developing receptive listening skills and productive speaking skills;
- writing texts using terminology in the field of informatics and information technology.

Teaching Methods: seminars and homework
Requirements/Prerequisites: Basic English
Assessment: Formative assessment throughout the course
Registration for the exam: N/A
References:
Basic Titles

1. M. Olejniczak, English for Information Technology, Vocational English coursebook,1, Pearson Longman, England, 2011.
2. М. Филипова, Практическа английска граматика, Емас, София, 2014.
3. R. Murphy, Essential Grammar in Use - Fourth Edition, Ниво A1 - B1: Граматика по английски език, Cambridge University Press, 2015.

Additional Titles

1. Zh. Paskalev, English-French-German-Russian-Bulgarian Dictionary of Standardized Terms in Information Technology, Lik and Central Educational Service "Progres", 2002, Sofia.
2. DICTIONARY OF e-TERMS IN THE INFORMATION SOCIETY - third version, https://www.mtc.government.bg/sites/default/files/uploads/glossary/it-rechnik-2020_nnn.pdf
3. Online dictionary of the most common technical terms - https://techterms.com/
4. Online dictionary of IT terms - https://www.computerlanguage.com/
5. https://www.ted.com/talks

Abbreviation:
FS: Fall Semester

MATHEMATICAL ANALYSIS 2

Semester: 2 semester
Course Type: lectures and seminars
Hours per Week: 3 lecture hours and 2 seminars hour / SS
ECTS Credits: 9.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Compulsory course in Mathematics B.C. Curriculum.
Course Description: The course in Mathematical Analysis 2 includes basic concepts of mathematical analysis: improper integral, functions of two and more variables; continuity of functions of several variables; partial derivatives, local and relative extrema; implicit functions; double and triple Riemann integral, and their applications for finding arias and volumes; line integrals of first and second type; surface integrals of first and second type; basic formulas for integrals of Mathematical Physics.
Course Aims: Students should obtain knowledge for Mathematical Analysis 2, which is a basic mathematical discipline. This knowledge is necessary for studying Mathematical Analysis 3, Ordinary Differential Equations, Numerical Methods, and Optimization.
Teaching Methods: lectures and seminars
Requirements/Prerequisites: Mathematical Analysis 1
Assessment: permanent control during the semester including homework and two written exams, and written exam in the semester's end on topics from tutorials and on topics from lectures.
Registration for the exam: coordinated with the lecturer and student Service Department
References
1. V. A. Ilin, V. A. Sadovnichi, B. H. Sendov – Mathematical Analysis, Vol. 1, Vol.2, Nauka and Izkustvo Publishing House, Sofia, 1989 (in Bulgarian).
2. V. Grozdanov, Mathematical analysis – first part, Publishing House Neofit Rilsky, 2015.
3. V. Grozdanov, Mathematical analysis – second part, Publishing House Neofit Rilsky, 2015.
4. V. Grozdanov, Mathematical analysis – third part, Publishing House Neofit Rilsky, 2015.
5. Yaroslav Tagamlitski – Differential Calculus, Nauka and Izkustvo Publishing House, Sofia, 1971 (in Bulgarian).
6. Yaroslav Tagamlitski – Integral Calculus, Nauka and Izkustvo Publishing House, Sofia, 1978 (in Bulgarian).
7. I. Prodanov, N. Hadjiivanov – Problem book in Differential and Integral Calculus, Nauka and Izkustvo Publishing House, Sofia, 1976 (in Bulgarian).
8. E. Varbanova, Lectures on Mathematical Analysis – I, Publishing house of Technical University Sofia, Sofia, 2009.
9. V. Grozdanov, K. Jordjev, A. Markovska, Methodological conduire for solving of problems

of Mathematical Analysis – first part, Publishing house "Neofit Rilsky" Blagoevgrad, 2012.
10. V. Grozdanov, K. Jordjev, A. Markovska, Methodological conduire for solving of problems of Mathematical Analysis – second part, Publishing house "Neofit Rilsky" Blagoevgrad, 2015.
11. V. Grozdanov, K. Jordjev, A. Markovska, Methodological conduire for solving of problems of Mathematical Analysis –third I, Publishing house "Neofit Rilsky" Blagoevgrad, 2015.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

ABSTRACT ALGEBRA 1

Semester: 2-nd semester
Course Type: Lectures and tutorials
Hours per week /FS/SS: 3 lecture hours and 2 tutorial hours /SS
ECTS credits: 9.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Short Description: The education of that discipline includes some of the main notations of the semigroup and group theory, ring and field theory, algebraic polynomials. The definitions are introduced in an abstract way and explained with many examples. The Cayley theorem, the Lagrange theorem and the main theorem for the cyclic groups are proved. The main tools for investigations of the symmetric group are described and the importance of the symmetric group is underlined in applications. Characteristics of field and simple fields are introduced. There is detailed analysis of certain important rings. In the last part the classical polynomial questions like quotient/remainder theorem, Euclid's algorithm, Horner's scheme, roots of polynomials, symmetric polynomials are considered.
Course Aims: The students have to obtain knowledge and skills for the theoretical foundations of the semigroup and group theory, ring and field theory, and polynomials as well as the applications of this apparatus for solving some practical tasks, related to other mathematical and informatical subjects. The obtained knowledge on this fundamental discipline are directed to be used by students in their education on other subjects.
Teaching Methods: lectures, tutorials, homework, and problem solving tests.
Requirements/Prerequisites: The students should have basics knowledge from Number theory and Linear algebra.
Assessment: permanent control during the semester including homework and two written exams, and written exam in the semester's end on topics from tutorials and on topics from lectures.
Registration for the exam: coordinated with the lecturer and student Service Department

References:
Basic Titles
1. A. Bojilov, P. Siderov, K. Chakaryan. Problems in Algebra, Vedi Press, Sofia, 2006 /in Bulgarian/.
2. K. Denecke, K. Todorov. Foundations of Algebra. University Press, South-West University "Neofit Rilski", Blagoevgrad, 2001 /in Bulgarian/.
3. K. Dochev, D. Dimitrov, V. Chukanov. Handbook on Algebra. Sofia, 1976 /in Bulgarian/.
4. S. Dodunekov, K. Chakaryan. Problems in Number Theory. Regalia Press, 1999 /in Bulgarian/.

5. G. Genov, S. Mihovski, T. Mollov, Algebra, University Press, "Paisii Hilendarski", Plovdiv, 2006 /in Bulgarian/.
6. A. Kurosh, Course on Algebra. Sofia, "Nauka I izkustvo", 1967 /in Bulgarian/.
7. I. Mihailov, N. Zyapkov. Algebra and Galois Theory, Faber Press, Veliko Tarnovo, 2004 /in Bulgarian/.
8. P. Siderov, K. Chakaryan. Notes on Algebra, Vedi Press, Sofia, 2006 /in Bulgarian/.

Additional Titles

1. D. K. Fadeev, I. S. Sominski. "Handbook on Algebra". Moscow, "Nauka", 1968 /in Russian/.
2. L. Ya. Okunev, Algebra, Moscow, 1949 /in Russian/.
3. I. V. Proskuriakov, "Handbook on Linear Algebra". Moscow, "Nauka", 1967 /in Russian/.
4. L. A. Skornyakov, Elements of Algebra. Moscow, 1986 /in Russian/.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

MATHEMATICAL LOGIC

Semester: 2 semester
Type of Course: lectures and tutorials
Hours per week: 2 lecture hours and 1 tutorial hour / SS
ECTS credits: 6.0 credits
Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Course description: The course Mathematical logic aims to teach the basic concepts and results of propositional and predicate logic and propositional and predicate calculus. It deals with concrete first-order theories.
Course Aims: The course is aimed at introducing students to the development of concepts and methods of mathematical logic within the context of development in mathematics.
Teaching methods: lectures, demonstrations, problem solving
Prerequisites: The acquired knowledge is useful.
Examination and assessment procedures: The estimation of the acquired knowledge is based on a written exam which consists of problem solving and theoretical knowledge examination (writing on a topic from the syllabus provided to students)
Registration for examination: coordinated with the lecturer and the academic affairs department.
References:

Basic Titles

1. E. Mendelson, Introduction to mathematical logic, Mir, Moscow, 1976.
2. S. Pasi & Collective, Lectures on Logic, "Kl. Ozhrideki" University, Sofia, 1990.
3. R. Smalian, Princess or Tiger?, Mir, Moscow, 1985.

Additional Titles

1. A concept of logic, 7-th ed. Hurley, Springer, 2009, http://ihtik.lib.ru/2012.03_ihtik_mathematic/
2. Robert Roth Stoll, Set Theory and Logic, Springer, 2009.
3. Shane Torbert, Applied Computer Science, 2011.
4. Akira Maruoka, Concise Guide to Computation Theory, 2011.

5. George Polya, How to Solve It: A New Aspect of Mathematical Method, 2008.

PRACTICAL COURSE IN MATHEMATICAL ANALYSIS

Semester: 2 semester
Course Type: Tutorials
Hours per week /FS/SS: 2 tutorial hours /FS
ECTS credits: 3.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Compulsory course in the B.S. Curriculum of Mahematics.
Short Description: The education of that discipline includes some of the basic notations in Mathematical Analysis, and the included topics are analyzed and implemented with the help of basic software.
Course Aims: The purpose of this course is to introduce students to the opportunity to use modern methods and tools for solving problems of Mathematical Analysis.
Teaching Methods: tutorials, homework and tests.
Requirements/Prerequisites: The students should have basic knowledge in Mathematical Analysis.
Assessment: permanent control during the semester including two homework and two tests, or an exam at the end of the semester.
Registration for the exam: coordinated with the lecturer and student Service Department

References
Basic Titles
1. I. Prodanov, N. Hadjivanov, I. Chobanov, Collection of Problems of Differential and Integral Calculation, Sofia, Science and Art, 1976.
2. V. Grozdanov, K. Jordjev, A. Markovska, Methodological conduire for solving of problems of Mathematical Analysis – first part, Publishing house "Neophit Rilsky" Blagoevgrad, 2012.
3. V. Grozdanov, K. Jordjev, Tz. Mitova, Methodological conduire for solving of problems of Mathematical Analysis –second part, Publishing house "Neophit Rilsky" Blagoevgrad, 2013.
4. V. P. Dyankov, MATLAB, DMK Press, Moscow, 2012 /in Russian/.
5. Hunt B., R. Lipsman, J. Rosenberg, K. Coombes, A Guide to MATLAB® for Beginners and Experienced Users Second Edition, Cambridge University Press, 2006.
6. MathWorks, MATLAB Programming Fundamentals, 2021
7. https://www.mathworks.com/

Abbreviation:
FS: Fall Semester
SS: Spring Semester

ENGLISH 2

Semester: 2 semester
Course type: seminars
Hours per week: 2 hours per week /SS
ECTS credits: 3.0 credits
Assessment: ongoing assessment

Department: Faculty of Phylology, SWU "Neofit Rilski" – Blagoevgrad
Course Status: Compulsory course in the B.S. Curriculum of Mathematics

Short Description: Throughout this second part of the course the students develop the knowledge and skills acquired in the first part. At the end of the course, students should have an active set of words and phrases corresponding to the language skills for levels A1 and A2, according to the Common European Framework of Reference for Languages. The course "English 2" focuses on productive skills for speaking and writing texts.

Course Aims:

-expanding informatics and computer science vocabulary;
-new grammar knowledge;
-understanding and writing specialized texts.

Requirements/Prerequisites: Basic English
Assessment: Formative assessment throughout the course
References

Basic Titles

1. D. Hill. English for Information Technology, Vocational English Course book 2, Pearson Longman, England, 2012
2. M. Filipova, Practical English Grammar, Emmas, Sofia, 2014.
3. R. Murphy, Essential Grammar in Use - Fourth Edition, Level A1 - B1: English Grammar, Cambridge University Press, 2015.

Additional Titles

1. Zh. Paskalev, English-French-German-Russian-Bulgarian Dictionary of Standardized Terms in Information Technology, Lik and TsUV "Progres", 2002, Sofia.
2. DICTIONARY OF e-TERMS IN THE INFORMATION SOCIETY – third version, https://www.mtc.government.bg/sites/default/files/uploads/glossary/it-rechnik-2020_nnn.pdf
3. Online dictionary of the most common technical terms - https://techterms.com/
4. Online dictionary of IT terms - https://www.computerlanguage.com/
5. https://www.ted.com/talks

Abbreviation:
SS: Spring Semester

MATHEMATICAL ANALYSIS 3

Semester: 3 semester
Course Type: lectures and seminars
Hours per Week: 3 lecture hours and 2 seminar hour / FS
ECTS Credits: 7.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory course in Mathematics B.C. Curriculum.
Short Description: The main topics to be considered:

- Complex numbers
- Holomorphic functions and Power series
- Elementary transcedental functions
- Integrals of complex-valued functions, Cauchy theorem and applications
- Taylor and Laurant series
- Classification of the isolated singular points
- Residue and applications

Course Aims: This course is an introduction to the classical Complex Analysis and its main purpose is to present some basic topics of the Theory of holomorphic functions of one variable as well as some of its applications.
Teaching Methods: Lectures, tutorials, homework, problem-solving tests. During the lectures students are acquainted with the basic theoretical material- definitions, theorems, applications, with the methods of theorems proofs. During seminars students solve practical problems. The knowledge obtained within the theoretical practice is used and it is also used in the process of problem solving.
Requirements/Prerequisites: Basic knowledge of courses in Mathematical Analysis 1 and 2 part and the course in Analytical Geometry is necessary.
Assessment: written exam on seminars and discussion on the theoretical material from the lectures.
Registration for the exam: Students and the lecturer agree on the convenient dates within the announced calendar schedule of examination session.

References

A. Basic Titles
1. T. Argirova, Theory of the analytical functions, Sofia, Science and Art, 1988.
2. L. Chakalov, An introduction of the theory of the analytical functions, Sofia, Science and Art, 1957.
3. L. Alfors, An introduction of the theory of the analytical functions, Sofia, Science and Art, 1971.
4. A. I. Marcuchevich, L. I. Marcuchevich, An introduction of the theory of the analytical functions, Moscow, 1977.

Additional Titles
1. T. Argirova, T. Genchev, Collection of problems of theory of the analytical functions, Sofia, Science and Art, 1986.
2. T. Argirova, T. Genchev, Fractional-linear function, Sofia, Science and Art, 1971.

Abbreviation
SS: Spring Semester
FS: Fall Semester

ORDINARY DIFFERENTIAL EQUATIONS

Semester: 3 semester
Course Type: lectures and seminars
Hours per week: 3 lecture hours and 2 tutorial hours /FS
ECTS credits: 7.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory course from Mathematics B.C. Curriculum.
Short Description: The main topics to be considered:
- Problem of Cauchy, existence and unit of the solution of the problem of Cauchy
- Differential equations of first and n-th order
- System of differential equations
- Applications of the differential equations

Course Aims: This course develops in detail the problems of differential equations and their applications

Teaching Methods: Lectures, tutorials, homework, problem-solving tests. During the lectures students are acquainted with the basic theoretical material- definitions, theorems, applications, with the methods of theorems proofs. During seminars students solve practical problems. The knowledge obtained within the theoretical practice is used and it is also used in the process of problem solving.
Requirements/Prerequisites: Basic knowledge of courses in Mathematical analysis
Assessment: written exam on seminars and discussion on the theoretical material from the lectures.
Registration for the exam: Students and the lecturer agree on the convenient dates within the announced calendar schedule of examination session.

References

A. Basic Titles

1. L. E. Elsgoltz, Differential equations and variation calculations, Nauka, Moscow, 1985.
2. G. Bradistilov, Higher Mathematics, part III, Technique, Sofia, 1965.
3. A. F. Filippov, Handbook of problems of differential equations, Scientific and Publishing Center „Regular and chaotic dynamics“, 2000.
4. V. Grozdanov, K. Iordjev, Tz. Mitova, Handbook of mathematical analysis, third part, University Publishing House “Neofit Rilsky”, Blagoevgrad, 2014.

B. Additional Titles

1. V. V. Stepanov, Course of differential equations, Nauka, Moscow, 1976.
2. S. Manolov et al. High Mathematics, part 3, Technique, Sofia, 1977.
3. Yaroslav Tagamlitsky, Differential Calculus, "Science and Art", Sofia, 1971.

Abbreviation
SS: Spring Semester
FS: Fall Semester

ABSTRACT ALGEBRA 2

Semester: 3 semester
Course Type: Lectures and tutorials
Hours per week: 2 lecture hours and 2 tutorial hours /FS
ECTS credits: 6.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University “Neofit Rilski” – Blagoevgrad.
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Short Description: The second part of the course in algebra for students in “Mathematics” developed the ideas of the first part. The course begins with the study of the rings of polynomials of one variable. The algebraic closeness of the field of complex numbers is proved. Some basic consequences of the d'Alembert theorem are considered. The decomposition of polynomials with real coefficients is studied. The existence of a root of indecomposable polynomial in a suitable extension of the field of constants is determined. The discriminant and resultant of polynomials are considered. A special attention is paid to solving nonlinear algebraic systems of equations using resultant and to solving algebraic equations of third and fourth degree, reciprocal equations, and binomial equations. Some extensions of the fields are studied. The question of the finite fields is also included. In view of the many applications in analysis and algebra itself the theory of λ-matrices and Jordan canonical form of numerical matrices are studied. The course ends with some elements of the theory of associative algebras.

Course Aims: The students have to obtain more deep knowledge and skills for the basic algebraic structures and polynomials of one variable as well as the applications of this apparatus for solving some practical tasks, related to other mathematical subjects. The obtained knowledge on this fundamental discipline are directed to be used by students in their education on other subjects. The content of the course gives the students the opportunity to be able to study alone or in some of the elective courses in more detail various aspects of algebra.
Teaching Methods: lectures, tutorials, homework, and problem solving tests.
Requirements/Prerequisites: The students should have good knowledge from Algebra 1.
Assessment: permanent control during the semester including homework and two written exams, and written exam in the semester's end on topics from tutorials and on topics from lectures.
Registration for the exam: coordinated with the lecturer and student Service Department

References

Basic Titles

1. A. Bojilov, P. Siderov, K. Chakaryan. Problems in Algebra, Vedi Press, Sofia, 2006 /in Bulgarian/.
2. K. Denecke, K. Todorov. Foundations of Algebra. University Press, South-West University "Neofit Rilski", Blagoevgrad, 2001 /in Bulgarian/.
3. K. Dochev, D. Dimitrov, V. Chukanov. Handbook on Algebra. Sofia, 1976 /in Bulgarian/.
4. S. Dodunekov, K. Chakaryan. Problems in Number Theory. Regalia Press, 1999 /in Bulgarian/.
5. G. Genov, S. Mihovski, T. Mollov, Algebra, University Press, "Paisii Hilendarski", Plovdiv, 2006 /in Bulgarian/.
6. A. Kurosh, Course on Algebra. Sofia, "Nauka I izkustvo", 1967 /in Bulgarian/.
7. I. Mihailov, N. Zyapkov. Algebra and Galois Theory, Faber Press, Veliko Tarnovo, 2004 /in Bulgarian/.
8. P. Siderov, K. Chakaryan. Notes on Algebra, Vedi Press, Sofia, 2006 /in Bulgarian/.

Additional Titles

1. D. K. Fadeev, I. S. Sominski. "Handbook on Algebra". Moscow, "Nauka", 1968 /in Russian/.
2. L. Ya. Okunev, Algebra, Moscow, 1949 /in Russian/.
3. I. V. Proskuriakov, "Handbook on Linear Algebra". Moscow, "Nauka", 1967 /in Russian/.
4. L. A. Skornyakov, Elements of Algebra. Moscow, 1986 /in Russian/.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

NUMBER THEORY

Semester: 3 semester
Type of the course: Lectures and tutorials
Hours per week: 2 lecture hours and 2 tutorial hours / FS
ECTS credits: 6.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Short Description: Main topics:

- Divisibility
- Primes and the Fundamental theorem of Arithmetic

- Congruences
- Fermat's, Euler's and Wilson's theorems
- Quadratic residues
- Diophantine equations
- Arithmetic functions

Course Aims: To develop in details the basic notions and methods of elementary Number theory and their applications for solving problems of divisibility, linear and quadratic congruences and Diophantine equations.

Teaching Methods: Lectures, tutorials, homework, problem-solving tests. During the lectures students are acquainted with the basic theoretical material – definitions, theorems and applications. During seminars students solve practical problems. The knowledge obtained within the theoretical practice is used in the process of problem solving.

Requirements/Prerequisites: Basic knowledge of the courses in Elementary Mathematics, Linear and Abstract Algebra.

Assessment: Written exam on problem solving and on the theoretical material from the lectures.

Registration for the exam: Students and the lecturer agree on the convenient dates within the announced calendar schedule of examination session.

References

Basic Titles

1. S. Dodunekov, K. Tchakarjan, Number theory problems, Regalia, 1999.
2. Lecture notes (www.moi.math.bas.bg/~peter).
3. T. Andreescu, D. Andrica, Number Theory, Birkhauser, 2009.

Additional Titles

1. J. Silverman, A Friendly Introduction to Number Theory, Prentice-Hall, Inc., 1997
2. P. Boivalenkov, E. Kolev, O. Mushkarov, N. Nikolov, Bulgarian Mathematical Competirions 2006 – 2008, UNIMATH, Sofia, 2008.
3. P. Boivalenkov, E. Kolev, O. Mushkarov, N. Nikolov, Bulgarian Mathematical Competirions 2009 – 2011, UNIMATH, Sofia, 2012.

Abbreviation

SS: Spring Semester
FS: Fall Semester

INTRODUCTION TO INFORMATION SYSTEMS AND TECHNOLOGIES

Semester: 3 semester

Course type: lectures and labs

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

ECTS credits: 4.0 credits

Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, SWU "Neofit Rilski" - Blagoevgrad.

Course Status: Compulsory course in the B.S. Curriculum of Mathematics.

Short Description: The course involves basic concepts such as information, data, knowledge, information system, business information systems, hardware and software components of IS etc. The problems related to ICT jobs, copyrights and law issues in ICT.

Course Objectives: The student should obtain basic knowledge in area of IT and IS.

Teaching Methods: lectures, lab work, discussions, project-based method.

Requirements/Prerequisites: No (introductory course)

Assessment and Evaluation:

- Project – 50%,
- Final Test – 50%.

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. Ralph M. Stair, George W. Reynolds, Fundamentals of Information Systems, Sixth Edition, 2012 Course Technology, Cengage Learning.
2. Brian K. Williams, Stacey C. Sawyer, Using Information Technology. A Practical Introduction to Computers & Communications, McGraw-Hill, 2011.
3. URL http://www.e-learning.swu.bg

DISCRETE MATHEMATICS

Semester: 4 semester
Type of the course: Lectures and tutorial
Hours per week: 2 lecture hours and 2 tutorial hours / FS
ECTS credits: 5.5 credits
Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Course Description: 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.
Assessment: 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 Students Department Office, co-ordinated with the lecturer.

References:

1. Y. Denev, S. Strakov, Discrete Mathematics, Blagoevgrad, 1995.
2. R. Pavlov, S. Radev, S. Strakov, Mathematical Foundations of Informatics, Blagoevgrad, 1997.
3. Y. Denev, R. Pavlov, Y. Demetrovich, Discrete Mathematics, Sofia, 1984.

4. T. Fujisawa, T. Kasami, Mathematics for Radio Engineers, Radio and Communication, Moscow, 1984.
5. K. Chimev, Sl. Shtrakov, Mathematics with Informatics, Blagoevgrad, 1989.
6. S. V. Jablonski, Introduction to Discrete Mathematics, Moscow, 1979.
7. S. V. Yablonski, G. P. Gavrilov, V. B. Kudryavtsev, Functions of Logic Algebra and Post Classes, Moscow, 1966.
8. Z. Manna, Mathematical theory of computation, McGraw-Hill Book Company, NY, 1974.
9. V. J. Rayward-Smith, A first course in formal language theory, Bl.Sc.Publ., London, 1983.
10. A. Salomaa, Jewels of formal language theory, Comp.Sc.Press, Rockville, 1981.
11. Peter Linz, An Introduction to Formal Languages and Automata, 2006, Jones & Bartlett Publishers.

MATHEMATICAL OPTIMIZATION

Semester: 4 semester
Course Type: lectures and tutorials
Hours per week/FS/SS: 3 lecture hours and 2 tutorial hours per week / SS
ECTS credits: 7.0 credits
Department: Department Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory course in the Mathematics B.S. Curriculum.
Short Description: The course in Mathematical Optimization (Mathematical Programming) includes basic results and methods for solving various types optimization problems and related topics: nonlinear optimization problems, linear optimization problems (simplex method, duality in linear optimization, transportation problem, assignment problem), matrix games (John von Neumann minimax theorem, graphical method for solving 2 x 2, 2 x *n*, and *m* x 2 games, relation between matrix games and linear optimization), convex analysis (convex sets, sum of sets and product of a set with a real number, projection of a point onto a set, separation of convex sets, extreme points, cones, polar cones, representation of convex cones, representation of convex sets, polyhedrons, convex functions, directional derivatives, subgradients and subdifferentials), convex optimization problems (Kuhn-Tucker theorem), quadratic optimization problems.
Course Aims: Students should obtain basic knowledge and skills for solving optimization problems under consideration.
Teaching Methods: lectures and tutorials
Requirements/Prerequisites: Mathematical Analysis, Linear Algebra, Analytic Geometry.
Assessment: written final exam
Registration for the course: not necessary
Registration for the exam: coordinated with the lecturer and Students Service Department
References
Basic Titles
1. P. Kenderov, G. Hristov, A. Dontchev – "Mathematical Programming", Kliment Ohridski Sofia University Press, Sofia, 1989 (in Bulgarian).
2. "Mathematical Programming Problem Book", Kliment Ohridski Sofia University Press, Sofia, 1989 (in Bulgarian).
3. M. Slavkova – "Mathematical Methods of Optimization", Sofia, 2000 (in Bulgarian).
4. M. Slavkova, Z. Tsenova – „Problem Book in Quantitative Methods and Statistics", Technical University, Sofia, 2011 (in Bulgarian).
5. S. M. Stefanov – "Quantitative Methods of Management", 2003 (in Bulgarian).

Additional Titles
6. Suresh Chandra, Jayadeva Aparna Mehra – "Numerical Optimization with Applications", Narosa Publishing House, New Delhi, 2013.
7. Andrew R. Conn, Katya Scheinberg, Luis N. Vicente – "Introduction to Derivative-Free Optimization", SIAM, Philadelphia, PA, USA, 2009.
8. I. Griva, S. G. Nash. A. Sofer – "Linear and Nonlinear Optimization", 2-nd. ed., SIAM, Philadelphia, 2009.
9. S. M. Stefanov – "Separable Optimization. Theory and Methods", Springer, New York, 2021.
10. Hamdy A. Taha – „Operations Research. An Introduction", 10-th ed., Pearson, USA, 2017.
11. William F. Trench – "The Method of Lagrange Multipliers", Trinity University, San Antonio, Texas, USA, 2013 (available online).

Abbreviation:
FS: Fall Semester
SS: Spring Semester

COMPLEX ANALYSIS

Semester: 4 semester
Type of the course: Lectures and tutorials
Hours per week /FS /SS: 2 lecture hours and 2 tutorial hour / SS
ECTS credits: 6.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Compulsory course in the Bachelor degree program of Mathematics.
Short Description: Main topics:

- Complex numbers and Mobius transformations
- Holomorphic functions
- Power series
- Conformal mappings
- Power series
- Elementary transcedental functions
- Cauchy theorem and applications
- Taylor and Laurant series
- Classification of the isolated singularities
- Residues and applications

Course Aims: This course is an introduction to the classical Complex Analysis and its main purpose is to present some basic topics of the Theory of holomorphic functions of one variable as well as some of its applications.
Teaching Methods: Lectures, tutorials, homework, problem-solving tests. During the lectures students are acquainted with the basic theoretical material- definitions, theorems, applications, with the methods of theorems proofs. During seminars students solve practical problems. The knowledge obtained within the theoretical practice is used in the process of problem solving.
Requirements/Prerequisites: Basic knowledge of the courses in Mathematical Analysis 1, 2 and 3, and the course in Analytic Geometry.
Assessment: Written exam on seminars and discussion on the theoretical material from the lectures.

Registration for exam: Students and the lecturer agree on the convenient dates within the announced calendar schedule of examination session.

References

Basic Titles

1. T. Argirova, Theory of analytic functions, Sofia, Science and Art, 1988.
2. L. Chakalov, An introduction of the theory of analytic functions, Sofia, Science and Art, 1957.
3. L. Alfors, An introduction of the theory of analytic functions, Sofia, Science and Art, 1971.

Additional Titles

1. P. Bojadjiev, V. Hadjiiski, Complex analysis, Sofia University Pres, Sofia, 2004.
2. V. Hadjiiski, Problems in Complex analysis, Vedi, Sofia, 1997.
3. T. Argirova, T. Genchev, Collection of Problems of theory of analytic functions, Sofia, Science and Art, 1986.
4. T. Argirova, T. Genchev, Mobius transformations, Sofia, Science and Art, 1971.

Abbreviation

SS: Spring Semester
FS: Fall Semester

PARTIAL DEFFERENTIAL EQUATIONS

Semester: 4 semester
Course Type: lectures and seminars
Hours per week: 3 lecture hours and 2 tutorial hours / SS
ECTS credits: 7.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory course from Mathematics B.C. Curriculum.
Course Description: The main topics to be considered: partial differential equations of hyperbolic, elliptic and parabolic types.
Course Aims: The course develops in details the problems of partial differential equations.
Teaching Methods: lectures, tutorials, homework, problem-solving tests, etc. During the lectures students are acquainted with the basic theoretical material: definitions, theorems, applications, methods of theorems proofs. During seminars students solve practical problems. The knowledge obtained within the theoretical practice is used in the process in problem solving.
Requirements/Prerequisites: Basic knowledge of courses of Mathematical Analysis and Ordinary differential equations.
Exam: written exam on problems and discussion on the theoretical material from lectures.
Registration for the exam: Coordinated with lecturer and Students Service Department

References

Basic Titles

1. T. Genchev, Partial differential equations, Nauka and izkustvo, Sofia, 1982.
2. T. Argirova, T. Genchev, Handbook of partial differential equations, Nauka and izkustvo, Sofia, 1985.

Additional Titles

1. A. Petrova-Deneva, V. Dimova-Nancheva, N, Stoyanov, Higher mathematics, part 5, Sofia, 1977.

2. A. Petrova-Deneva, Methodological guide for solving problems in higher mathematics, part 5, Tehnika, Sofia, 1978.

Abbreviation:
SS: Spring Semester

NUMERICAL ANALYSIS 1

Semester: 5 semester
Course Type: lectures and lab exercises
Hours per Week/FS/SS: 3 lecture hours and 2 lab hours per week / FS
ECTS Credits: 7.5 credits
Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory Course in the Mathematics B.S. Curriculum
Course Description: The course in Numerical Analysis 1 includes basic numerical methods of mathematical analysis, algebra, and differential equations: interpolation and least squares data fitting as methods for approximating functions given by tabulated data; numerical differentiation; numerical integration – Newton-Cotes and Gauss quadrature formulas; numerical solution of nonlinear equations; numerical solution of linear systems of algebraic equations; numerical solution of the initial-value problem for ordinary differential equations of first order; numerical solution of the boundary value problem for ordinary differential equations of second order; and variational methods for solving operator equations (including differential equations).
Course Objectives: Students should obtain knowledge and skills for numerical solutions of problems in the area of mathematical analysis, algebra and differential equations, which are applicable for solving various problems.
Teaching Methods: lectures and lab exercises
Requirements/Prerequisites: Mathematical Analysis, Linear Algebra, Analytic Geometry, Differential Equations
Assessment: written final exam covering problems /omitted in case the average grade of two current problem tests is higher than Very Good 4.50/ (grade weight is 30 %) and theory on two topics (grade weight is 30 %); two homework (grade weight is 20 %) and two projects (grade weight is 20 %)
Registration for the course: not necessary
Registration for the exam: coordinated with lecturer and Student Service Department

References:

Basic Titles:
1. B. Boyanov – "Lectures on Numerical Analysis", Darba Publishing House, Sofia, 1995 (in Bulgarian).
2. M. Kaschiev – "Numerical Analysis Handbook", Martilen Publishing House, Sofia, 1994 (in Bulgarian).
3. "Numerical Analysis Problem Book", 2-nd ed., St. Kliment Ohridski Sofia University Press, Sofia, 1994 (in Bulgarian).
4. V. Pasheva – "Introduction to Numerical Analysis", Technical University-Sofia, 2009.
5. Bl. Sendov, V. Popov – "Numerical Analysis", Part I, Kliment Ohridski Sofia University Press, Sofia, 1996; Part II, Nauka and Izkustvo Publishing House, Sofia, 1978 (in Bulgarian).

Additional Titles:
6. R. L. Burden, J. D. Faires – "Numerical Analysis", 9-th ed., Cengage Learning, Stamford, CT, USA, 2011.

7. Rizwan Butt – "Introduction to Numerical Analysis using Matlab", Jones and Bartlett Publishers, Sudbury, MA, USA, 2009.
8. J. D. Faires, R. L. Burden – "Numerical Methods", 4-th ed., Brooks/Cole Publishing Company, Pacific Grove, CA, USA, 2013.
9. Timothy Sauer – "Numerical Analysis", 2-nd ed., Pearson Education, London, 2011.
10. S. M. Stefanov – "Numerical Analysis", MS4004-2203, Limerick, 1998.
11. William F. Trench – "Elementary Differential Equations with Boundary Value Problems. Student Manual", Trinity University, San Antonio, Texas, USA, 2013 (available online).

Abbreviation:
FS: Fall Semester
SS: Spring Semester

DIFFERENTIAL GEOMETRY

Semester: 5 semester
Course Type: Lectures and tutorials
Hours per week: 3 lecture hours and 2 tutorial hours / FS
ECTS credits: 7.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Short Description: The course includes: studying of basic themes of the classical differential geometry of the curves, the one-parametric sets of straight lines and the surfaces in the three-dimensional real Euclidean space.
Course Aims:
The students have to obtain knowledge and skills for application of the differential-geometric methods for learning of geometric objects.
Teaching Methods: Lectures, tutorials, home works, problem solving tests.
Requirements/ Prerequisites: Analytic Geometry, Mathematical Analysis, Differential Equations.
Assessment: written exam on topics from tutorials and on topics from lectures.
Registration for the Exam: coordinated with the lecturer and Student Service Department.

References
Basic Titles
1. A. Borisov, Differential Geometry. University Press, South-West University "Neofit Rilski" Blagoevgrad, 1994 (in Bulgarian).
2. A. Gjonov, Handbook on Differential Geometry. Sofia, 1999 (in Bulgarian).

Additional Titles
1. I. Ivanova-Karatopraklieva, Differential Geometry. University Press "St. Kl. Ohridski", Sofia, 1994 (in Bulgarian).
2. B. Petkanchin, Differential Geometry. Sofia, 1964 (in Bulgarian).
3. G. Stanilov, Differential Geometry. Sofia, 1997 (in Bulgarian).

Abbreviation:
SS: Spring Semester
FS: Fall Semester

GRAPH THEORY

Semester: 4 semester
Type of Course: lectures and seminars
Hours per week: 2 lecture hours + 1 seminar hour / SS
ECTS credits: 6.0 credits
Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Course 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).
- Matching and assignment algorithms (introduction and examples, maximum-cardinality matching in a bipartite graph).
- The chinesse 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).

Course Aims: Students should obtain basic knowledge in Graph theory and skills for solving optimization problems for graphs and networks.
Teaching Methods: lectures, tutorials, individual student's work
Requirements/Prerequisites: Graphs, Discrete Optimization, Linear Optimization.
Assessment: 3 homework D1, D2, D3; 2 tests K1, K2 (project); written final exam
Rating: = 0,2.(D1+D2+D3)/3 + 0,5.(K1+K2)/2 + 0,3.(Exam)
Registration for the Exam: coordinated with the lecturer and Students Service Department

References

1. Iv. Mirchev, “Graphs. Optimization algorithms for networks”, Blagoevgrad, 2001 (in Bulgarian).
2. Iv. Mirchev, “Mathematical programming”, Blagoevgrad, 2000 (in Bulgarian).
3. E. Minieka, “Optimization Algorithms for Networks and Graphs, Marcel Dekker, Inc., New York and Basel, 1978.
4. N. Christofides, Graph Theory. An Algorithmic approach, Academic Press lnc., London, 1975, 1997
5. M. Swami, K. Thulasirman, „Graphs, Networks and Algorithms“, John Wiley & Sons, 1981.

THEORY OF PROBABILITY AND STATISTICS 1

Semester: 6 semester
Type of Course: lectures and tutorials in computer lab
Hours per week: 2 lecture hours and 2 tutorial hours tutorials in computer lab / SS
ECTS credits: 8.0 credits
Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University “Neofit Rilski” – Blagoevgrad.
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Course description: In this course, questions of Probability and Mathematical Statistics are considered. Algorithms connected with finding structural and numerical characteristics of graphs 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 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 Exam: Coordinated with the lecturer and the Student Service Office.

References

Basic Titles

1. E. Karastranova Interactive Probability Training and Statistics, Blagoevgrad, 2010.
2. B. Dimitrov, N. Yanev, Probability and Statistics, Sofia, 2001.
3. K. Kalinov, Statistical Methods in Behavioral and Social Sciences, NBU, 2010.
4. P. Kopanov, V. Noncheva, S. Hristova, Probabilities and statistics, manual for solving problems, Paisii Hilendarski University Publishing House, 2012.

Additional Titles:

1. http://www.teststat.hit.bg
2. R. Madgerova, V. Kyurova, Statistika v turizma, SWU, 2009 (in Bulgarian).

STEM EDUCATIONAL TECHNOLOGIES IN SCIENCE, MATHEMATICS AND INFORMATICS EDUCATION

Semester: 6 semester
Type of Course: lectures, laboratory exercises
Hours per week: 1 hour lecture, 1 hour laboratory exercise
ECTS credits: 5.5 credits
Department: Department of Mathematics and Physics, South-West University "Neofit Rilski" – Blagoevgrad.
Course status: Compulsory course in the B.S. Curriculum of Mathematics.
Course description: The use of technology is a powerful factor, both for increasing the cognitive activity of students, and for strengthening their interest in studying natural sciences, mathematics and computer science. The modernization of the educational process is also associated with the need to emphasize the applied nature of natural knowledge in various aspects. In the modern world of dynamic changes, the rapid flow of information and innovative technologies affect every sphere of our lives. However, there is a certain contradiction between the progress of technology and the decreased interest of students in natural disciplines. That is why the use of combinations of interdisciplinary, practically oriented approaches in studying the disciplines, as well as the application of modern methods, laid down in STEM (Science - Technology - Engineering - Mathematics) education, will lead to the formation of a scientific and technical elite. The main idea of the course is to familiarize students with an educational environment - a STEM center, which will allow, through the implementation of innovative technologies and software solutions, to illustrate various aspects of the educational material in the educational process of future specialists in natural sciences, mathematics and informatics.
Objectives: The aim of this course is to familiarize students with the STEM environment, which will help them to show creativity and will prepare them for successful future realization in different spheres of life, developing their logical thinking, problem-solving skills, digital literacy and emotional intelligence.
Methods of teaching: Lectures, laboratory exercises, discussions.
Pre-requirements: Basic knowledge of mathematics, informatics and information technologies is required.
Assessment:
• current control - 60% of the assessment;
• written exam – 40% of the grade.
Registration for the Exam: Agreed with the teacher and the academic department.

References

Basic Titles

1. Angelov A., Momcheva G., Srebreva T., Successful work with an interactive whiteboard, RAABE, 2013.
2. Blume, B., Digital education, RAABE, 2022.
3. Garov, K., Harizanov K., Angelov A., Gardeva G., Multimedia, Arts, 2013.
4. Momcheva G., Nenkov S., Guide to working with an interactive whiteboard, 2014.
5. Bocconi, S., Ott, M., Overcoming the concepts of educational software and assistive technologies, 2014.
6. Doering, A., Veletsianos, G., Teaching with educational software, 2009.
7. Pjanic, K., Hamzabegovic, J., Are future teachers methodically trained to distinguish good from bad educational software? Practice and Theory in Education Systems, 11 (1), 2016, 36-44.

8. https://interactivebg.com/obrazovatelni-tehnologii/zspace-bulgaria/zspace-aio-all-in-one-rabotna-stancia/
9. https://wiki.geogebra.org/bg/%D0%A3%D1%80%D0%BE%D1%86%D0%B8?lang=bg
10. https://www.mozaweb.com/bg/mozabook
11. https://zspace.com/edu

Additional Titles:

1. Betcher C., Lee M., The interactive whiteboard revolution: teaching with IWBs, ACER Press, 2009.
2. Cennamo, K., Ross, J., Ertmer, P.A., Technology integration for meaningful use in the classroom: A standards-based approach. Wadsworth Publishing. 2013.
3. Digregorio P., Sobellojeski K., The Effects of Interactive Whiteboards (IWBs) on Student. Performance and Learning, J. Educational Technology Systems, Vol. 38(3) 255-312, 2009-2010.
4. Roblyer, M.D., Doerings, A., Integrating educational technology into teaching, New Jersey: Pearson Education, (73-108).
5. Sharma P. etc, 400 Ideas for Interactive Whiteboards, MACMILLAN, 2011.
6. https://edutechflag.eu/%D0%BA%D0%BD%D0%B8%D0%B3%D0%B8?fbclid=IwAR0C9SitnEoSqABankD3hMEqSZcMbx_NGS6c2f5_8HoOm7YYx2EuHbB99CQ
7. https://klett.bg/stem/package
8. https://www.mastersindatascience.org/resources/teaching-stem-education-virtually/
9. https://www.researchgate.net/publication/355444596_Obucenieto_po_STEM_-_harakteristiki_i_problemi
10. https://www.teachmeteamwork.com/files/sanders.istem.ed.ttt.istem.ed.def.pdf

NUMERICAL ANALYSIS 2

Semester: 6 semester
Course Type: lectures and lab exercises
Hours per Week/FS/SS: 2 lecture hours and 2 lab hours per week / SS
ECTS Credits: 8.0 credits
Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory Course in the Mathematics B.S. Curriculum
Course Description: The course in Numerical Analysis 2 includes basic results of uniform approximation (Chebyshev alternation theorem, uniform approximation with positive linear operators), variational methods for solving operator equations (in particular, boundary value problem for second-order ordinary differential equations), methods for solving partial differential equations (elliptic, hyperbolic and parabolic), as well as basic methods for solving Voltera and Fredholm integral equations of second kind (method of mechanical quadratures, method of degenerate kernels, method of successive approximations /resolvent kernels method/).
Course Objectives: Students should obtain knowledge about uniform approximations, variational methods for solving operator equations, basic numerical methods for solving partial differential equations, and the theory and methods for solving integral equations, which are applicable for solving various real-world problems.
Teaching Methods: lectures and lab exercises
Requirements/Prerequisites: Mathematical Analysis, Linear Algebra, Analytic Geometry, Differential Equations
Assessment: written final exam covering problems /omitted in case the average grade of two current problem tests is higher than Very Good 4.50/ (grade weight is 30 %) and theory on two

topics (grade weight is 30 %); two homework (grade weight is 20 %) and two projects (grade weight is 20 %)
Registration for the course: not necessary
Registration for the exam: coordinated with lecturer and Student Service Department

References

Basic Titles

1. B. Boyanov – "Lectures on Numerical Analysis", Darba Publishing House, Sofia, 1995 (in Bulgarian).
2. M. Kaschiev – "Numerical Analysis Handbook", Martilen Publishing House, Sofia, 1994 (in Bulgarian).
3. "Numerical Analysis Problem Book", 2-nd ed., St. Kliment Ohridski Sofia University Press, Sofia, 1994 (in Bulgarian).
4. V. Pasheva – "Introduction to Numerical Analysis", Technical University-Sofia, 2009.
5. Bl. Sendov, V. Popov – "Numerical Analysis", Part I, Kliment Ohridski Sofia University Press, Sofia, 1996; Part II, Nauka and Izkustvo Publishing House, Sofia, 1978 (in Bulgarian).

Additional Titles

1. R. L. Burden, J. D. Faires – "Numerical Analysis", ", 9-th ed., Cengage Learning, Stamford, CT, USA, 2011.
2. Rizwan Butt – "Introduction to Numerical Analysis using Matlab", Jones and Bartlett Publishers, Sudbury, MA, USA, 2009.
3. J. D. Faires, R. L. Burden – "Numerical Methods", 4-th ed., Brooks/Cole Publishing Company, Pacific Grove, CA, USA, 2013.
4. Timothy Sauer – "Numerical Analysis", 2-nd ed., Pearson Education, London, 2011.
5. S. M. Stefanov – "Numerical Analysis", MS4004-2203, Limerick, 1998.
6. William F. Trench – "Elementary Differential Equations with Boundary Value Problems. Student Manual", Trinity University, San Antonio, Texas, USA, 2013 (also available online).

Abbreviation:
FS: Fall Semester
SS: Spring Semester

PRACTICAL COURSE IN DIFFERENTIAL EQUATIONS

Semester: 6 semester
Course Type: Tutorials
Hours per week /FS/SS: 2 tutorial hours / SS
ECTS credits: 4.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Short Description: The education of that discipline includes some of the basic notations in Ordinary Differential equations and Partial differential equation of hyperbolic, elliptic and parabolic types, and the included topics are analyzed and implemented with the help of basic software.
Course Aims: The purpose of this course is to introduce students to the opportunity to use modern methods and tools for solving differential equations.
Teaching Methods: tutorials, homework and tests.

Requirements/Prerequisites: The students should have basic knowledge in Differential equations.
Assessment: permanent control during the semester including two homework and two tests, or exam at the end of the semester.
Registration for the exam: coordinated with the lecturer and student Service Department

References:

Basic Titles
1. T. Genchev, Partial Differential Equations, Nauka i izkustvo, Sofia, 1982.
2. V. Grozdanov, K. Yordzhev, Ts. Mitova, Handbook of mathematical analysis, third part, University Publishing House "Neofit Rilsky", Blagoevgrad, 2014.
3. V. P. Dyankov, MATLAB, DMK Press, Moscow, 2012 /in Russian/.
4. A. F. Filippov, Handbook of problems of differential equations, Scientific and Publishing Center „Regular and chaotic dynamics", 2000.
5. D. Houcque, Introduction to Matlab For Engineering Students, Northwestern University, 2005.
6. B. Hunt, R. Lipsman, J. Rosenberg, K. Coombes, A Guide to MATLAB® for Beginners and Experienced Users Second Edition, Cambridge University Press, 2006.
7. MathWorks, MATLAB Programming Fundamentals, 2021.
8. https://www.mathworks.com/

Additional Titles
1. S. Manolov et al., Higher Mathematics, part 3, Technique, Sofia, 1977.
2. M. Nikolova, Matlab Materials, http://ns.naval- acad.bg/MNikolova/uchebni.htm, 2014.
3. A. Petrova-Deneva, V. Dimova-Nancheva, N. Stoyanov, Higher Mathematics, part 5, Sofia, 1977.
4. J. Attia, Electronics and circuit analysis using MATLAB, CRC Press, 1999.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

SPECIALIZED STATISTICAL SOFTWARE

Semester: 7 semester
Type of course: lectures and tutorials in computer lab
Hours per week: 2 lecture hours and 1 tutorial hours in computer lab / FS
ECTS Credits: 6.0 credits
Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Course description: The course Specialized statistical software /Statistical analysis of data with the help of IT (MS Excel, Statistica, SPSS)/ should introduce students to apply the methods of statistics in practice with the tools of IT. The main objectives of modeling the empirical data and application in the IT are introduced in the course. Contemporary technologies used for their application (MS EXCEL, SPSS and STATISTICA) are also included in the course.
Objectives:
- To give students theoretical knowledge of the main statistical procedures, as well as some specifics of their usage.
- To teach students how to create models for statistical analysis of experimental data.
- To present contemporary IT for statistical analysis to the students.

- To prepare students for their future research.

After successfully completing the course, the students should:

- know and be able to apply procedures for statistical analysis of experimental data;
- manage to create, edit, export and import data in contemporary IT;
- be able to create models for statistical analysis of experimental data.

Methods of teaching: lectures, tutorials, discussions, project-based method, simulations
Pre-requirements: Probability and Statistics, Information Technology
Assessment and Evaluation:

Project- 30%
Final Test- 30%
Individual students works-40%

The course is successful completed with **at least 50% of all scores**.
Registration for the course: not required
Registration for the exam: coordinated with the lecturer and the Student Service Office

References

Basic Titles

1. K. Kalinov, Statistical Methods in Behavioral and Social Sciences, NBU, 2010.
2. Richard A. Johnson, Dean W. Wichern. Applied Multivariate Statistical Analysis, Sixth ed., Prentice Hall, 2007.
3. Richard G. Bereton, Data analysis for the laboratory and Chemical Plant, University of Bristol, UK, 2009.
4. The Statistics Homepage - http://www.statsoft.com/textbook/stathome.html ©1984-2008
5. David C. Young, COMPUTATIONAL CHEMISTRY, A Practical Guide for Applying Techniques to Real-World Problems, John Wiley & Sons, Inc., 2001.

Additional Titles

1. E. Karashtranova, Interactive Probability Training and Statistics, Blagoevgrad, 2010.

OPERATIONS RESEARCH

Semester: 7 semester
Course Type: lectures, seminars
Hours per week: 2 lecture hours and 2 seminar hours per week / FS
ECTS credits: 7.5 credits
Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Course Description: The aim of the research operation is quantitative analysis and finds a solution by management system.
Course Aims: Students should obtain knowledge and skills to find the optimal solution of the analyzing problem**.**
Teaching Methods: lectures, demonstrations and work on project
Requirements/Prerequisites: Linear algebra, Computer languages. optimization theory.
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. H. A. Eiselt, Operations Research: A Model-Based Approach (Springer Texts in Business and Economics), Springer, Heidelberg NY, 2012.

2. Hamdy A. Taha, Operations Research: An Introduction, Prentice Hall, 2010.
3. Ravi Ravindran, Donald P. Warsing Jr.Supply Chain Engineering: Models and Applications (Operations Research Series), Jonson and Son, 2012.
4. E. S. Ventzel, Operations Research, Nauka, Moscow, 1988 (in Russian).
5. G. Vagner, Operational research, Vol. I-III, 1998.
6. Yu. P. Zaichenko, Operations Research, Kiev, 1988 (in Russian).

Abbreviation:
FS: Fall Semester
SS: Spring Semester

FUNDAMENTALS OF GEOMETRY

Semester: 7 semester
Course Type: lectures and tutorials
Hours per Week/FS/SS: 2 lecture hours and 1 tutorial hour per week / FS
ECTS credits: 6.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Compulsory course in Mathematics B.C. Curriculum.
Short Description: The course includes studying of the following basic topics: Hilbert's axiomatic, Kolmogorov's metric axiomatic and Well's axiomatic of the Euklidean Geomery and their equivalence is proved.
Course Aims: Students should obtain knowledge and skills about rigorous construction of mathematical discipline.
Teaching Methods: lectures, tutorials, homeworks and tests.
Requirements/Prerequisites: High School Mathematics
Assessment: written exam on topics from lectures.
Registration for the course: by request at the end of the current semester
Registration for the exam: coordinated with lecturer and Student Service Department

References
Basic Titles
1. A. Borisov, A. Langov. Foundations of geometry. Blagoevgrad, Univ. Publishing House „Neofit Rilski", 2009.
2. Ch. Lozanov, A. Langov, G. Eneva. Synthetic Geometry, University Press „St. Kl. Ohridski", Sofia, 1994.
3. B. Petkanchin, Foundations of mathematics. Sofia, Science and Art, 1968.
Additional Titles
1. N. Martinov, Geometry. Sofia, Science and Art, 1968.
2. D. Hilbert, Foundations of geometry. Science and Art, 1978.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

FUNDAMENTALS OF ARITHMETIC

Semester: 7 semester
Course Type: Lectures and tutorials

Hours per week: 2 lecture hours and 1 tutorial hours / FS
ECTS credits: 6.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Short Description: The compulsory course in Fundamentals of the Arithmetic has the objective to make the students familiar with the notation of "number" and connected with it operations and ordinance relation. The course comprises the natural numbers, the integer numbers, the rational numbers, and the real numbers and in particular cases the complex numbers. The course start with the definition of the notation "finite set" and the notation "induction set", which was introduced in the beginning of the 20-th century by B. Russell. The course pays attention to the notation natural number; to the operations addition and multiplication of two natural numbers; to the laws that they satisfy; to the inequality between two natural numbers. The students should learn to pass from a decimal system to an arbitrary system. The course continuing with extensions of the semiring of the natural numbers to the ring of the integer numbers, also to the semifield of the fractions and their ordinances. The course finishes with the consideration of the real and the complex numbers.
Course Aims: Students should obtain knowledge and skills for the recent theoretical ideas and the whole scholar course of education in Algebra.
Teaching Methods: lectures, tutorials, homework, and problem solving tests.
Requirements/Prerequisites: The students should have basics knowledge from Number theory and High algebra.
Assessment: permanent control during the semester including homework and two written exams, and written exam in the semester's end on topics from tutorials and on topics from lectures.
Registration for the exam: coordinated with the lecturer and student Service Department

References

Basic Titles
1. Kl. Denecke, K. Todorov, Fundamentals of Arithmetic, Blagoevgrad 1999
2. N. Ziapkov, N. Yankov, I. Mihailov. Elementary Number Theory. „Faber", Veliko Tarnovo, 2008.
3. P. Petkov. Fundamentals of Arithmetic. Library of the Faculty of mathematics in University "Kliment Ohridski", Sofia.

Additional Titles
1. B. Petkanchin, Fundamentals of Mathematics, Sofia, 1959.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

CONSTRUCTIVE THEORY OF FUNCTIONS

Semester: 8 semester
Course Type: Lectures amd seminars
Hours per week: 2 lecture hours and 1 seminar hour per week / SS
ECTS credits: 5.0 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Short Description: The main topics to be considered:

- Uniform approximations
- Quadratic approximations
- Fourier series

Course Aims: This course develops in details the problems of apprimation of functions.
Teaching Methods: Lectures, homework, problem-solving tests. During the lectures students are acquainted with the basic theoretical material- definitions, theorems, applications, with the methods of theorems proofs. The knowledge obtained within the theoretical practice is used and it is also used in the process of problem solving.
Requirements/Prerequisites: Basic knowledge of courses in mathematical analysis.
Assessment: written exam and discussion on the theoretical material from the lectures.
Registration for the course: by request at the end of the current semester
Registration for the exam: Students and the lecturer agree on the convenient dates within the announced calendar schedule of examination session.

References

Basic Titles
1. I. P. Natanson, Constructive theory of functions, State publishing technical–theoretical literature, Moscow-Leningrad, 1949.

Additional Titles
1. Papers.

THEORY OF PROBABILITY AND STATISTICS 2

Semester: 8 semester
Type of Course: lectures and tutorials in computer lab
Hours per week: 2 hours lectures and 1 hour tutorial in computer lab
ECTS credits: 6.0 credits
Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Compulsory course in the B.S. Curriculum of Mathematics.
Course description: In this course topics of Probability and Mathematical Statistics are considered. Algorithms connected with finding structural and numerical characteristics of graphs 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 between Mathematics-Informatics-Physics-Economics and other sciences.
Methods of teaching: seminars, tutorials, discussions, project-based method.
Pre-requirements: Theory of probability and statistics I, Analysis, 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 exam: coordinated with the lecturer and the Student Service Office.

References

Basic Titles
1. K. Kalinov, Statistical Methods in Behavioral and Social Sciences, NBU, 2010.

2. Richard A. Johnson, Dean W. Wichern. Applied Multivariate Statistical Analysis, Sixth ed., Prentice Hall, 2007.
3. Richard G. Bereton, Data analysis for the laboratory and Chemical Plant, University of Bristol, UK, 2009.
4. The Statistics Homepage - http://www.statsoft.com/textbook/stathome.html ©1984-2008
5. David C. Young, COMPUTATIONAL CHEMISTRY, A Practical Guide for Applying Techniques to Real-World Problems, John Wiley & Sons, Inc., 2001.

Additional Titles

1. E. Karashtranova, Interactive Probability Training and Statistics, Blagoevgrad, 2010.

OPTIONAL COURSES

FIRST GROUP

SEMIGROUP THEORY

Semester: 4-th semester
Course Type: Lectures
Hours per week: 3 lecture hours / SS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Short Description: The term "semigroup" first appeared in mathematical literature in the beginning of XX century, but the theory of semigroups really began at the end of the 20s. At 60 years of XX century the theory of semigroups becomes dynamically developing area of modern algebra with a wide variety of problems and different applications. During these years, appeared the first books devoted to the theory of semigroups. In recent years, the semigroups have been extensively studied in different aspects by many authors in Bulgaria and in many famous mathematical centers abroad. The relationship between semigroups, languages and automata is one of the most important aspects of contemporary semigroup theory. They also occur in theoretical computer science, coding theory, differential equations, functional analysis, mathematical linguistics, and many other areas. The course begins with the study of basic concepts, properties and examples of the theory of semigroups. Ideals, congruence and theorems for homomorphism and isomorphism of semigroups are considered. Particular attention is paid to the Green's relations and symmetric semigroup. The course continued with the study of a number of semigroups with specific properties such as regular semigroups, inverse semigroups, simple semigroups, Rees matrix semigroups and free semigroups.
Course Aims: The purpose of this course is to introduce students to the basic theory of the semigroups and its applications to the other mathematical disciplines. The content of the course gives the students the opportunity to be able to study alone and in more details the theory of the semigroups; to be able to follow other courses that use semigroup theory; to be able to attend specialized scientific seminars in algebra; to be able to reading articles and books in this field.
Teaching Methods: lectures, homework, and problem solving tests.
Requirements/Prerequisites: The students should have basics knowledge from Algebra.
Assessment: permanent control during the semester including homework and two written exams, and written exam in the semester's end on topics from lectures.
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

Basic Titles

1. A. H. Clifford and G. B. Preston, The algebraic theory of semigroups, Vol. I & II, Mathematical Surveys of the Amer. Math. Soc. 7, 1961 & 1967.
2. J. M. Howie, An introduction to semigroup theory, Academic Press, 1976.
3. J. M. Howie, Fundamentals of semigroup theory, Clarendon Press, 1995.
4. M. Petrich, Introduction to semigroups, Merrill, Columbus, Ohio, 1973.
5. M. Petrich, Inverse semigroups, Wiley, New York, 1984.

6. Е. С. Ляпин, Полугрупы, Государственное издательство физико-математической литературы, Москва, 1960.

Additional Titles

1. P. M. Higgins, Techniques of semigroup theory, Oxford University Press, 1992.
2. G. Lallement, Semigroups and combinatorial applications, Wiley, 1979.

REPRESENTATION THEORY OF GROUPS

Semester: 4-th semester
Course Type: Lectures
Hours per week: 3 lecture hours / SS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Short Description: Group theory is the oldest part of algebra that studies the properties of algebraic structures (such as linear spaces, groups, semigroups, rings, algebras and others.). One of the main reasons for the numerous applications of group theory in other areas of mathematics, physics, chemistry and other natural sciences is that groups can be represented through its effect on other objects - as inverse images of sets on himself and inverse linear operators in linear spaces. Theory of representations of groups studying algebraic properties of these acts of abstract and concrete important groups. It is used to obtain new results in the theory of groups, as well as for number of applications in other areas such as geometry, physics, chemistry, crystallography, and even architecture.
Course Aims: The purpose of this course is to introduce students to the basic theory of group representation and its applications to algebra, coding theory and crystallography. The content of the course gives the students the opportunity to be able to follow other courses that use this theory as well as to read articles and books in this field.
Teaching Methods: lectures, homework, and problem solving tests.
Requirements/Prerequisites: The students should have basics knowledge from Algebra.
Assessment: permanent control during the semester including homework and two written exams, and written exam in the semester's end on topics from lectures.
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. A. I. Kostrikin, Introduction to Algebra, Nauka, Moscow, 1977.
2. S. Lang, Algebra, Third Edition, Addison-Wesley, Reading, Mass., 1993.
3. I. N. Herstein, Noncommutative Rings, Carus Math. Monographs 15, Wiley and Sons, Inc., New York, 1968.
4. C. W. Curtis, I. Reiner, Representation Theory of Finite Groups and Associative Algebras, Reprint of the 1962 original, Providence, RI: AMS Chelsea Publishing, 2006.
5. T. A. Springer, Invariant Theory, Lect. Notes in Math. 585, Springer-Verlag, 1977.

INTRODUCTION TO LATEX

Semester: 4 semester
Type of Course: Lectures and tutorials in computer lab.
Hours per week: 2 hours lectures and 1 hour tutorials in computer lab / SS.
ECTS credits: 4.5 credits

Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Short Description: The Course is an Introduction in LATEX 2e used as a word processor when preparing text in mathematical, computer and other sciences. The course includes the following sections:

- Scripts and visual word;
- Classes of documents, packages and styles;
- A set of mathematical formulas;
- Mathematical graphics in LATeX 2e;
- Settings of LATeX 2e;
- BEAMER class for presentations in LATeX 2e.

The course focuses on the practical utilization of the material on the basis of numerous examples.
Course Aims: The course aims to provide knowledge to students in philosophy and history of LATeX 2e, a computer program created by Donald Knuth and intended for processing text and mathematical formulas.
Teaching Methods: lectures, group discussions or workshops, projects, other methods.
Requirements/Prerequisites: Basic knowledge in Mathematics and Programming.
Exam: final exam
Registration for the course: by request at the end of the current semester
Registration for the exam: coordinated with the lecturer and the Student Service Office

References

1. Leslie Lamport, A document Preparation System LATEX user's guide and reference manual, Addison-Wesley, 1998.
2. Till Tantau, Joseph Wright, Vedran Miletić, User's guide – The BEAMER class, manual for version 3.07, 2010, http://www.ctan.org/tex-archive/macros/latex/contrib/beamer/doc/beameruserguide.pdf
3. Norm Matloff', Quick Tutorial on the Beamer Package for Slide Making in LaTeX, http://heather.cs.ucdavis.edu/~matloff/beamer.html
4. T. Oetiker, H. Partl, I. Hyna, E. Schlegel, The Not So Short Introduction to LATEX 2e, 2004, http://www.download.bg/?cls=program&id=446489
5. http://fmi.uni-sofia.bg/fmi/or/TeX/LaTeXBG.pdf

INTRODUCTION TO CODING THEORY

Semester: 4-th semester
Course Type: Lectures and seminars
Hours per week: 2 lecture hours + 1 seminar hour per week / SS
ECTS credits: 4.5 credits
Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Course description: The training starts with definition and description of the notion of a cryptosystem and introduction of the classical cryptosystems with examples and theoretical background. If necessary, the basic notions (modular arithmetic, theorems of Fermat and Euler) are introduced. The main types of attacks are considered as basis for cryptoanalysis

understanding. The modern block ciphers DES and AES are explained and analyzed, as well as some systems for digital signatures.
Scope of the course: Students will acquire skills and knowledge for the theoretical background and practical application of the cryptography for data protection. Skills for evaluation of the strong/weak features of cryptographic systems will be developed.
Teaching Methods: lectures, discussions, practice with working and educational examples of cryptosystems, course work.
Preliminary requirements: Basic notions from number theory and linear algebra.
Assessment: current control during the semester (two written tests and course work).
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 Student Educational Office.

References
1. Lecture notes.
2. D. E. Denning, Cryptography and data security, Addison-Wesley Publishing Company, 1982, http://faculty.nps.edu/dedennin/publications/Denning-CryptographyDataSecurity.pdf .
3. V. V. Yaschenko, Cryptography, an introduction, Student Mathematical Library, vol. 18, American Mathematical Society, 2002 (превод от руски).
4. A. J. Menezes, P. C. van Oorschot, S. A. Vanstone, Handbook of applied cryptography, CRC Press, 2001.

SECOND GROUP

MATHEMATICAL STRUCTURES

Semester: 5 semester
Type of the course: Lectures and tutorials
Hours per week /FS /SS: 2 lecture hours and 1 tutorial hour / SS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Optional course in the B. S. Curriculum of Mathematics.
Short Description: The main topics to be considered: Study of the main mathematical structures. The natural systems are constructed by an axiomatic approach. The other number systems are worked up constructively.
Course Aims: The students to obtain knowledge on the described scientific areas.
Teaching Methods: Lectures, tutorials, homework, problem-solving tests. During the lectures students are acquainted with the basic theoretical material- definitions, theorems, applications, with the methods of theorems proofs. During seminars students solve practical problems. The knowledge obtained within the theoretical practice is used and it is also used in the process of problem solving.
Requirements/Prerequisites: Basic knowledge of courses in Algebra and mathematical analysis.
Assessment: written exam on seminars and discussion on the theoretical material from the lectures.
Registration for the exam: Students and the lecturer agree on the convenient dates within the announced calendar schedule of examination session.

References

Basic Titles

1. G. Bradistilov, Foundation of the mathematics, Sofia, Science and Art, 1964.
2. P. Radnev, Foundation of the school course of algebra and analysis, Paisii Hilendarsky Publishing House, Plovdiv, 1984.

Abbreviation:

SS: Spring Semester
FS: Fall Semester

SYMMETRIC SEMIGROUPS

Semester: 5-th semester
Course Type: Lectures
Hours per week /FS/SS: 3 lecture hours / FS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Short Description: Symmetric semigroups (transformation semigroups) belong to the most fundamental objects in Mathematics. They arise naturally as endomorphism semigroups of various mathematical structures. They also occur in theoretical computer science, where properties of languages depend on algebraic properties of various transformation semigroups related to them. Transformation semigroups are of essential importance for the structure theory of finite state machines or automata. They also occur in the theory of digital networks by viewing a state machine as a network composition of coupled smaller state machines, of which there are five basic types (since there are five non-isomorphic semigroups of order 2). Of course, transformation semigroups are also of great importance for semigroup theory, as every semigroup is isomorphic to a transformation semigroup. The course begins with the study of basic concepts, properties and examples of the theory of semigroups. Particular attention is paid to the Green's relations for symmetric semigroups. Some special elements like idempotents, regular and inverse elements, as well as generating sets and rank of semigroups are considered. The course continued with the study of a number of symmetric semigroups with specific properties such as semigroups of order-preserving or order-reversing transformations, semigroups of orientation-preserving or orientation-reversing transformations, partial symmetric semigroups, symmetric inverse semigroups.
Course Aims: The purpose of this course is to introduce students to the basic theory of the symmetric semigroups and its applications to the other mathematical disciplines. The content of the course gives the students the opportunity to be able: to study alone and in more details the theory of the symmetric semigroups; to follow other courses that use semigroup theory; to attend specialized scientific seminars in algebra; to read articles and books in this field.
Teaching Methods: lectures, projects, and presentations.
Requirements/Prerequisites: The students should have basic knowledge in Abstract algebra.
Assessment: permanent control during the semester including one project and presentation, and exam at the end of the semester.
Registration for the exam: coordinated with the lecturer and Student Service Department

References

Basic Titles

1. A. H. Clifford and G. B. Preston, The algebraic theory of semigroups, Vol. I & II, Mathematical Surveys of the Amer. Math. Soc. 7, 1961 & 1967.
2. O. Ganyushkin, V. Mazorchuk, Classical finite transformation semigroups, Springer-Verlag, London, 2009.
3. J. M. Howie, An introduction to semigroup theory, Academic Press, 1976.
4. J. M. Howie, Fundamentals of semigroup theory, Clarendon Press, 1995.
5. M. Petrich, Introduction to semigroups, Merrill, Columbus, Ohio, 1973.
6. M. Petrich, Inverse semigroups, Wiley, New York, 1984.
7. Е. С. Ляпин, Полугрупы, Государственное издательство физико-математической литературы, Москва, 1960.

Additional Titles

1. P. M. Higgins, Techniques of semigroup theory, Oxford University Press, 1992.
2. G. Lallement, Semigroups and combinatorial applications, Wiley, 1979.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

EXTREMUM PROBLEMS IN THE HIGH SCHOOL COURSE OF MATHEMATICS

Semester: 5 semester
Вид на курса: lectures and seminars
Hours per week: FS/SS/: 2 lecture hours and 1 seminar hour per week / FS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional course in the B.S. Curriculum of Mathematics
Short Description: In this course, the basic results and methods for solving various classes of extremum problems and problems, connected with modeling of processes and phenomena, are studied.
Course Aims: Students should obtain basic knowledge about the theory and methods for solving extremum problems and modeling of processes and phenomena in the high school course in mathematics.
Teaching Methods: lectures and seminars
Requirements/Prerequisites: Basic knowledge in Mathematical Analysis and Mathematical Optimization.
Assessment: written exam
Registration for the course: by request at the end of the previous academic year
Registration for the exam: Coordinated with the lecturer and Student Service Department

References

Basic Titles

1. O. Mushkarov, L. Stoyanov – "Extreme Problems in Geometry", Narodna Prosveta, Sofia, 1989.
2. G. Paskalev, Nadezhda Raynova – "Extreme Problems in Geometry: Methodology and Solutions", Archimedes Publishing House, Sofia, 2003.
3. Konstantin Petrov – "Guide to Solving Problems in Mathematics", Narodna Prosveta, Sofia, 1987.

Additional Titles
1. E. Beckenbach, R. Bellman – "Introduction to Inequalities", Mir, Moscow, 1965.
2. P. Kenderov, G. Hristov, A. Donchev – "Mathematical Optimization", University Publishing House "Kliment Ohridski", Sofia, 1989.
3. Collective – "Guide to Solving Problems in Mathematical Optimization", University Publishing House "Kliment Ohridski", Sofia, 1989.
4. Y. Ninova, D. Rakovska, V. Baligand – "Extreme Problems", in the collection "Mathematics and Mathematical Education", Publishing House of the Bulgarian Academy of Sciences, SMB, Sofia, 1990, pp. 515-519.
5. Diana Rakovska, Vivian Baligand, Yulia Ninova – "Extreme Problems", Journal "Education in Mathematics and Informatics", vol. 5, 1989, p. 39-45.
6. C. M. Tikhomirov - "Tales about maximums and minimums", Nauka, Moscow, Kvant Library, issue 56, 1986.
7. D. O. Shklyarskyi, N. N. Chentsov, I. M. Yaglom - "Geometric Inequalities and Maximum and Minimum Problems", Nauka, Moscow, Mathematical Circle Library, issue 12, 1970.
8. Hamdy A. Taha - "Operations Research. An Introduction", 10th ed., Prentice Hall, USA, 2017.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

FUNDAMENTALS OF MODELING

Semester: 5-th semester
Course Type: Lectures and tutorials
Hours per week /FS/SS: 2 lecture hours and 1 tutorial hour /FS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Short Description: The program contains the traditional material for the fundamentals of mathematical modeling. The course starts with the concept of modeling and what is the essence of modeling. A classification of mathematical models has been made and a large number of elementary models from different fields are considered - physics, chemistry, biology, medicine, economics and others.
Course Aims: The purpose of this course is to introduce students to the essence of mathematical modeling and some basic models from different fields of science.
Teaching Methods: lectures, tutorials, projects, and presentations.
Requirements/Prerequisites: The students should have basic knowledge in Differential and Integral Calculus.
Assessment: permanent control during the semester including one project and presentation, and exam at the end of the semester.
Registration for the exam: coordinated with the lecturer and student Service Department

References
Basic Titles
1. A. Samarskii, A. Mihailov, Mathematical Modeling. Ideas. Methods. Examples, MAIK, Moscow, 2001 (in Russian).

2. V. Ashihman, M. Gitman, Introduction to Mathematical Modeling, Logos, Moscow, 2007 (in Russian).
3. K. Bonev, N. Lalova, A. Ivanov, Mathematical Modeling, Georgi Bakalov Publishing House, Varna, 1989 (in Bulgarian).
4. N. Moiseev, A. Petrov, Mathematical Modeling: Methods for Describing and Research of Complex Systems, Nauka, Moscow, 1989 (in Russian).
5. S. V. Zvoranev, Fundamentals of Mathematical Modeling, Ekaterinburg, Ural University Publishing House, 2019 (in Russian).
6. D. Mooney, R. Swift, A Course in Mathematical Modeling, The Mathematical Association of America, 1999.

Additional Titles

1. S. V. Kashtaeva, Mathematical Modeling, Perm, Prokrost Publishing Center, 2020 (in Russian).
2. G. Dangelmayr, M. Kirby, Mathematical Modeling - A Comprehensive Introduction, Prentice Hall, Upper Saddle River, New Jersey, 2005.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

MATHEMATICAL MODELS IN ECONOMICS

Semester: 5 semester
Course Type: Lectures and tutorials
Hours per week: 2 lecture hours and 1 tutorial hour per week / SS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Course Description: The presented course on mathematical models in economics examines models that are often used in macroeconomics and microeconomics. The set of mathematical models that to one degree or another correctly describe economic processes can be united under the name "Mathematical Economics". This includes models of production activity (the so-called real economy) and financial and credit activity. The course presents methods of modeling pricing and taxation. From the point of view of mathematics, issues of forecasting and regulation of the economy are considered and analyzed.
Course Aims: The course presented in the program introduces mathematics students to mathematical models of economic phenomena; it provides an opportunity to study the possibilities of applying these models and methods in practice.
Teaching Methods: lectures and seminars
Assessment: written exam
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. H. A. Eiselt, Operations Research: A Model-Based Approach (Springer Texts in Business and Economics), Springer Heidelberg NY, 2012.
2. Лекции по теория на игрите, 2012, www.gametheory.net
3. Rob Kaas, Marc Goovaerts, Modern Actuarial Risk Theory Using R, Springer, 2008.

4. Alasdair Smith. A Mathematical Introduction to Economics. Blackwell, 1982 (in English); Kliment Ohridski Publishing House, 2000 (in Bulgarian).
5. P. Kenderov, G. Hristov, A. Donchev, Mathematical Optimization, Kliment Ohridski Publishing House, 1989 (in Bulgarian).
6. M. M. Kovalev, Discrete Optimization, Minsk, BSU Publishing House, 1977 (in Russian).
7. H. Weyl, Elementary theory of convex polyhedra, In: Matrix Games, Fizmatgiz, Moscow, 1966 (in Russian).

HISTORY OF MATHEMATICS

Semester: 5-th semester
Course Type: lectures
Hours per Week: 3 lecture hours per week/ FS
Number of credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Course Description: It includes basic steps of the development of mathematical knowledge until the end of 20-th century.
Objectives: Basic steps of the development of mathematical knowledge until the end of 19-th century are presented to students and they are given an idea how to use that knowledge in their future work as teachers in mathematics.
Teaching Methods: lectures and consultations.
Pre-requirements: Knowledge from the School course in Mathematics.
Assessment and Evaluation: written exam
Registration for the course: according to the rules for optional courses.
Registration for the exam: coordinated with lecturer and Student Service Office

References

Basic Titles
1. B. Bomarskii, Essays on the History of Mathematics, Minsk, 1979 (in Russian).
2. Iv. Ganchev, History of Mathematics, 1999 (in Bulgarian).
3. D. Ya. Stroik, Short Essay on the History of Mathematics, Moscow, 1988 (in Russian).

Additional Titles
1. B. L. van der Waerden, Awakening Science, Sofia, 1968 (in Bulgarian).
2. I. Ya. Denman, History of Arithmetic, Moscow, 1959 (in Russian).
3. Internet.

FUNCTIONAL EQUATIONS IN EXTRACURRICULAR WORK IN MATHEMATICS

Semester: 5 semester
Course Type: lectures and seminars
Hours per week / FS/SS/: 2 lecture hours and 1 seminar hour per week / FS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Course Aims: Students should obtain basic knowledge about functional equations and their use in the extracurricular work in mathematics at high school.

Teaching Methods: lectures, seminars, discussions, consultations, homeworks, control works.
Registration for the course: according to the rules for optional courses.
Registration for the exam: coordinated with the Student Service Department.

THIRD GROUP

PRACTICAL COURSE IN MATHEMATICAL MODELING WITH MATLAB

Semester: 6 semester
Course Type: Lectures and tutorials
Hours per week /FS/SS: 1 lecture hours and 2 tutorial hours / SS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Short Description: The course is intended for students with an interest in mathematical modeling. MATLAB supports both numeric and symbolic modeling approaches and provides curve fitting, statistics, optimization, ODE and PDE solving, calculus, and other core mathematical tools. Simulink adds an environment for modeling and simulating the behavior of multidomain systems and for developing embedded systems.
Course Aims: The course discusses the basic functions of Matlab software and how to create programs with Matlab. Particular attention is paid to programming and creating custom programs to solve mathematical models. The purpose of the laboratory tutorials is to acquaint students with Simulink and Matlab's rich capabilities for calculating boundaries, derivatives, integrals, functions and application of Matlab in mathematical modeling.
Teaching Methods: lectures, tutorials and problem-solving tests.
Requirements/Prerequisites: Basic knowledge of mathematics and disciplines such as Linear Algebra, Analytic Geometry, Mathematical Analysis is required.
Assessment: permanent control during the semester including two written exams, and a written exam at the end of the semester on topics from tutorials and on topics from lectures.
Registration for the exam: coordinated with the lecturer and student Service Department

References

Basic Titles

1. R. Colgeren, Basic MATLAB®, Simulink® and Stateflow®, AIAA, 2007.
2. Chen Ke, P. Giblin, A Irving, Mathematical Explorations with MATLAB, Cambridge University Press, 1999.
3. B. Hunt, R. Lipsman, J. Rosenberg, K. Coombes, A Guide to MATLAB® for Beginners and Experienced Users Second Edition, Cambridge University Press, 2006.
4. J. Mathews, K. Fink, Numerical methods using Matlab, Third Edition, Prentice Hall, 1999.
5. V. P. Dyakonov, MATLAB, DMK Press, Moscow, 2012. (in Russian)
6. Y. L. Ketkov, A. Y. Ketkov, M. M. Schultz, MATLAB 7: Programming, numerical methods, BHV-Peterburg, 2005. (in Russian)
7. M. Nikolova, Matlab Help, http://ns.naval-acad.bg/MNikolova/ uchebni.htm, 2014. (in Bulagian)
8. https://www.mathworks.com/

Additional Titles

1. A. Angermann, M. Beuschel, M. Rau, U. Wohlfarth, MATLAB® – Simulink® – Stateflow®, Oldenbourg Wissenschaftsverlag, 2011. (in German)
2. J. Attia, Electronics and circuit analysis using MATLAB, CRC Press, 1999.
3. C. Chapra Steven, Applied Numerical Methods with MATLAB for Engineers and Scientists, McGraw-Hill Scienc, 2011.
4. V. P. Dyakonov, MATLAB 6.5 SP1/7 + Simulink 5/6® in mathematics and modeling, SOLON-Press, Moscow, 2005. (in Russian)

Abbreviation:
FS: Fall Semester
SS: Spring Semester

NUMERICAL METHODS MONTE CARLO

Semester: 6-th semester
Course Type: Lectures and seminars
Hours per week: 2 lecture hours + 1 seminar hour per week / FS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Short Description: The main topics to be considered:

- Elements of the probability theory;
- Brawnian motion;
- Variance reduction;
- Stochastic methods.

Course Aims: This course develops in details notions and theorems of the described scientific problems.
Teaching Methods: Lectures, tutorials, homework, problem-solving tests. During the lectures students are acquainted with the basic theoretical material- definitions, theorems, applications, with the methods of theorems proofs. During seminars students solve practical problems. The knowledge obtained within the theoretical practice is used and it is also used in the process of problem solving.
Requirements/Prerequisites: Basic knowledge of courses in mathematical analysis, theory of the probability, theory of numbers and others.
Assessment: written exam on seminars and discussion on the theoretical material from the lectures.
Registration for the course: by request at the end of the current semester
Registration for the exam: Students and the lecturer agree on the convenient dates within the announced calendar schedule of examination session.

References
Basic Titles

1. Hui Wang, Monte Carlo Simulations with Applications to Finance, A Chapman & Hall, London, New York, 2012.

Additional Titles
Papers on different subjects.

Abbreviation:
SS: Spring Semester
FS: Fall Semester

SPECIAL MATRICES

Semester: 6-th semester
Course Type: Lectures and tutorials
Hours per week /FS/SS: 2 lecture hours and 1 tutorial hour / FS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Short Description: The optional course in Special Matrices has the objective to make the students familiar: with the basic sort of matrices, which have place in different fields of Mathematics and their applications; with methods for its reduce to a canonical form; with some undecided problems in the fields of the matrices. The course extends and expands the students' knowledge, which they have from the course in Linear Algebra. The lecture course shows the current status of this material, and it is built on the notation of "vector space". The course begins with an overview of the basic concepts of the Linear Algebra. The concepts of linear space, linear transformations and linear operators, and their matrices are recalled. Linear spaces with metrics (Euclidean and Unitary spaces) and the Symmetric (Hermitian) and Orthogonal (Unitary) operators acting in them, and their matrices are considered. Definitions and examples of bilinear and quadratic forms as well as their matrices on a fixed basis are given. Students get acquainted with polynomial matrices, Jordan matrices, block matrices and operations with them.
Course Aims: Students should obtain knowledge and skills for basic concepts under consideration. They should successfully use the methods for their calculation.
Teaching Methods: lectures, tutorials, homework, and problem-solving tests.
Requirements/Prerequisites: The students should have basic knowledge in Linear algebra.
Assessment: permanent control during the semester including homework and two written exams, and a written exam at the semester's end on topics from tutorials and on topics from lectures.
Registration for the exam: coordinated with the lecturer and student Service Department

References

Basic Titles

1. A. Borisov, Il. Guidzhenov, Il. Dimitrova. "Linear Algebra". University Press, South-West University "Neofit Rilski", Blagoevgrad, 2009 /in Bulgarian/.
2. A. Borisov, M. Kacarska. "Handbook on Linear Algebra and Analytic Geometry". University Press, South-West University "Neofit Rilski", Blagoevgrad, 2011 /in Bulgarian/.
3. G. Genov, S. Mihovski, T. Mollov. "Algebra", University Press "Paisii Hilendarski", Plovdiv, 2006 /in Bulgarian/.
4. K. Denecke, K. Todorov. "Linear Algebra". University Press, South-West University "Neofit Rilski", Blagoevgrad, 1992 /in Bulgarian and German/.

Additional Titles

1. M. Aslanski, B. Giurov. "Handbook on Linear Algebra". University Press, South-West University "Neofit Rilski", Blagoevgrad, 1999 /in Bulgarian/.
2. D. Dimitrov, "Collections of Problems on Linear Algebra". Sofia, 1978 /in Bulgarian/.
3. K. Dochev, D. Dimitrov. "Linear Algebra". Sofia, 1977 /in Bulgarian/.
4. A. I. Maltsev, "Fundamentals of Linear Algebra". Moscow, 1970 /in Russian/.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

MATHEMATICAL MODELS IN BIOLOGY AND MEDICINE

Semester: 6 semester
Course Type: Lectures and seminars
Hours per week: 2 lecture hours and 1 seminar hour per week / SS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Short Description: Students should obtain knowledge about basic mathematical models in biology and medicine.
Teaching Methods: Lectures, seminars, consultations.
Registration for the exam: Students and the lecturer agree on the convenient dates within the announced calendar schedule of examination session.

FOURTH GROUP

SPECIALIZED MATHEMATICS SOFTWARE

Semester: 7 semester
Course Type: Lectures and tutorials
Hours per week /FS/SS: 1 lecture hours and 2 tutorial hours / FS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Short Description: The idea of the course is to deepen the knowledge of students about classical and modern math software.
Course Aims: The aim of this course is for students to get acquainted with the different types of specialized software in mathematics. Particular attention is paid to software products for input, calculation and visualization of mathematical problems.
Teaching Methods: lectures, tutorials and project.
Requirements/Prerequisites: Basic knowledge of Mathematics and Informatics is required.
Assessment: permanent control during the semester including Course project and written exam in the end of the semester on topics from tutorials and on topics from lectures.
Registration for the exam: coordinated with the lecturer and student Service Department

References
Basic Titles

1. Adem Kilicmana, Munther A. Hassanb, S.K. Said Husainc, Teaching and Learning using Mathematics Software "The New Challenge", ICMER 2010.
2. Ajit Kumar, S. Kumaresan, Use of Mathematical Software for Teaching and Learning Mathematics, Mexico, 2008.

3. Juan Carlos Ponce Campuzano, Art & Animations, https://www.geogebra.org/m/dP275wS7
4. https://mathworld.wolfram.com/about/

Additional Titles

1. Russell Herman, Gabriel Lugo, Open Source Resources for Teaching and Research in Mathematics, University of North Carolina Wilmington, 2008, Retrieved 11 June 2013.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

SPECIFIC STEM EDUCATIONAL TECHNOLOGIES IN MATHEMATICS EDUCATION

Semester: 7 semester
Course Type: Lectures and tutorials
Hours per week /FS/SS: 1 lecture hour and 2 tutorial hours / FS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Short Description: In today's rapidly changing and technological society, mathematics and science education is crucial for developing the necessary competencies of young people. Mathematical competence is the ability to demonstrate and apply mathematical thinking and understanding in solving a range of tasks in everyday situations. This competence refers to the ability to explain nature by using a set of knowledge and methods to identify different cases and solve them. The research approach in STEM education is of utmost importance - it is a link between the natural sciences and their real-life application. That is why mathematics and the idea of mathematical modeling should be considered an essential element of all STEM areas and the methodologies for teaching mathematics should be in sync with the STEM approach. They challenge students to explore and model mathematical concepts, to build the meaning and connection between different academic disciplines and their real-life application in real-life cases. That is why the development of mathematical competences is an important factor for future realization in the labor market.
Course Aims: The goal of this course is for students to gain hands-on experience in a STEM environment, which will allow them to implement innovative technologies and software solutions in the field of mathematics. This will help them to be creative and prepare for successful future implementation in various spheres of life, developing their logical thinking, problem-solving skills, digital literacy and emotional intelligence.
Teaching Methods: lectures and tutorials.
Requirements/Prerequisites: Basic knowledge of mathematics and information technology is required.
Assessment:
• current control – 60% of the grade;
• written exam – 40% of the grade.
Registration for the exam: coordinated with the lecturer and student Service Department

References

Basic Titles

1. Blume, B., Digital Education, RAABE, 2022.
2. Garov, K., Harizanov K., Angelov A., Gardeva G., Multimedia, Arts, 2013.
3. Bocconi, S., Ott, M., Overcoming the Concepts of Educational Software and Assistive Technologies, 2014.
4. Doering, A., Veletsianos, G., Teaching with Educational Software, 2009.
5. Pjanic, K., Hamzabegovic, J., Are Future Teachers Methodically Trained to Distinguish Good from Bad Educational Software? Practice and Theory in Education Systems, 11 (1), 2016, 36-44.
6. http://www.jumpido.com/bg
7. https://get.plickers.com/
8. https://interactivebg.com/obrazovatelni-tehnologii/zspace-bulgaria/zspace-aio-all-in-one-rabotna-stancia/
9. https://kahoot.com/schools/interactive-lessons/
10. https://learningapps.org/
11. https://play.google.com/store/apps/details?id=com.stemonmobile.GeometryPad&hl=en_US&pli=1
12. https://prezi.com/education/?click_source=logged_element&page_location=product_card&element_text=prezi_for_education&occupation_selector=true
13. https://stembg.org/steam-pozitivni-rolevi-modeli-i-obuchenieto-po-matematika/
14. https://wiki.geogebra.org/bg/%D0%A3%D1%80%D0%BE%D1%86%D0%B8?lang=bg
15. https://www.canva.com/
16. https://www.intechopen.com/chapters/68547
17. https://www.scilab.org/software/scilab

Additional Titles

1. Cennamo, K., Ross, J., Ertmer, P.A., Technology Integration for Meaningful Use in the Classroom: A Standards-Based Approach. Wadsworth Publishing. 2013.
2. Roblyer, M.D., Doerings, A., Integrating Educational Technology into Teaching, New Jersey: Pearson Education, (73-108).
3. https://azbuki.bg/uncategorized/stem-podhod-v-obuchenieto-po-matematika-vav-vtori-klas/
4. https://create.vista.com/
5. https://curipod.com/
6. https://eurydice.eacea.ec.europa.eu/publications/mathematics-and-science-learning-schools-2022?etrans=bg
7. https://klett.bg/stem/package
8. https://www.mastersindatascience.org/resources/teaching-stem-education-virtually/
9. https://www.mindmeister.com/app/home/welcome
10. https://www.researchgate.net/profile/Nataliya-Pavlova/publication/306361232_SOFTUERNI_TEHNOLOGII_ZA_SZDAVANE_NA_DIDAKTICESKI_MATERIALI_ZA_OBUCENIETO_PO_MATEMATIKA/links/57bae37f08aed66b5db68ac2/SOFTUERNI-TEHNOLOGII-ZA-SZDAVANE-NA-DIDAKTICESKI-MATERIALI-ZA-OBUCENIETO-PO-MATEMATIKA.pdf

Abbreviation:

FS: Fall Semester

SS: Spring Semester

NUMERICAL METHODS FOR EXTREMAL PROBLEMS

Semester: 7 semester
Course Type: lectures and lab exercises
Hours per Week/FS/SS: 2 lecture hours and 1 lab hour per week / FS
ECTS Credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad
Course Status: Optional Course in the Mathematics B.S. Curriculum
Course Description: The course in Numerical Optimization includes basic numerical methods for solving various classes of optimization problems: line search methods – dichotomous search, golden section method, Fibonacci search, Newton's method; unconstrained optimization methods – nongradient methods (cyclic coordination method, method of Hooke and Jeeves, method of Rosenbrock), gradient methods (steepest descent method), methods of second order (Newton's method, modifications), as well as conjugate directions methods (conjugate gradients method: method of Fletcher-Reeves, method of Polak-Ribiere; quasi-Newton methods: method of Davidon-Fletcher-Powell); constrained optimization – methods of feasible directions (of Zoutendijk, of Rosen, of Wolfe [of the reduced gradient]), penalty and barrier functions methods; nonsmooth analysis and methods for nondifferentiable (nonsmooth) optimization; stochastic programming; separable programming; dynamic programming; vector (multi-objective) optimization and Pareto optimality.
Course Objectives: Student should obtain knowledge and skills for numerical solution of optimization problems.
Teaching Methods: lectures and lab exercises
Requirements/Prerequisites: Basic knowledge in Mathematical Analysis, Linear Algebra, Analytic Geometry, Mathematical Optimization.
Assessment: written final exam on two topics (grade weight is 60 %); two homework 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

Basic Titles

1. Yu. P. Zaichenko – "Operations Research", Slovo, Kiev, 2003 (in Russian).
2. V. G. Karmanov – "Mathematical Programming", 6-th ed., Fizmatlit, Moscow, 2008 (in Russian).
3. Stefan M. Stefanov – "Quantitative Methods of Management", 2003 (in Bulgarian).

Additional Titles

1. M. S. Bazaraa, H. D. Sherali and C. M. Shetty – "Nonlinear Programming. Theory and Algorithms", John Wiley & Sons, Inc., New York, 3-rd ed., 2006.
2. R. Fletcher – "Practical Methods of Optimization", 2-nd ed., John Wiley & Sons, Chichester-New York-Brisbane-Toronto-Singapore, 2000.
3. Jorge Nocedal, Stephen Wright – "Numerical Optimization", 2-nd ed., Springer, 2006.
4. Stefan M. Stefanov – "Separable Optimization. Theory and Methods", Springer, New York, 2021.

Abbreviation:
FS: Fall Semester
SS: Spring Semester

DECISION MAKING ALGORITHMS IN MANAGEMENT AND ECONOMICS

Semester: 7 semester
Course Type: lectures, tutorials
Hours per week: 2 lecture hours and 1 tutorial hour per week / FS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional Course in the Mathematics B.S. Curriculum
Course Description: The course Decision making support algorithms in economics and management includes four basic topics: The first topic is dedicated to decision making methods by voting. Some basic voting algorithms and methods are considered; The second topic includes basic methods and algorithms for solving of multi-objective (vector) problems; The third topic is dedicated to the application of game theory in optimal decision making; The fourth topic includes some methods and algorithms for decision making in risk conditions, and uncomplete information.
Course Objectives: Student should obtain knowledge and skills for some basic methods and algorithms supporting decision making.
Teaching Methods: lectures, tutorials and homework projects.
Requirements/Prerequisites: Basic knowledge in Mathematical Analysis, Linear Algebra, Analytic Geometry, Mathematical Programming, Probability Theory.
Assessment: written final exam (grade weight is 60 %); two homework projects (grade weight 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. V. A. Abchuk. "7:1 The Alphabet of the Solutions", Tehnika, Sofia, 1986 (in Bulgarian).
2. T. R. Gichev, Z. K. Karamiteva. "Game Theory", Nauka i Izkustvo, Sofia, 1980 (in Bulgarian).
3. G. H. Ivanov et al. "Guide for Methematical Programing Problem Solving", UNI, Sofia, 1989 (in Bulgarian).
4. E. S. Venttzel. "Operation Research", Nauka, Moscow, 1988 (in Russian).
5. Yu. I. Degtyarev. "Operation Research", Higher School, Kiev, 1986 (in Russian).
6. Yu. K. Mashunin. "Vector Optimization – Methods and Models", Nauka, Moscow, 1986 (in Russian).
7. Vira Chankong, Yacov Y. Haimes. Multiobjective Decision Making: Theory and Methodology Series, Volume 8, North-Holland, New York, Amsterdam, Oxford.
8. D. Dochev, J. Petkov. Decision Making Theory. Varna, Nauka i Ikonomika, 2008.
9. K. Tenekedjiev, N. Nikolov, D. Dimitrakieva. Theory and Practics of the Riscs Decisions. MASR, 2002.

FIFTH GROUP

MULTIVALUED FUNCTIONS AND DIFFERENTIAL INCLUSIONS

Semester: 8 semester
Course Type: lectures and seminars

Hours per week /SS: 2 lecture hours and 1 seminar hour per week / SS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional Course in the Mathematics B.S. Curriculum
Course Description: The course includes multivalued analysis and multivalued differential equations (inclusions).
Course Objectives: Students should obtain knowledge about basic concepts and results in the area of multivalued analysis and multivalued differential equations (inclusions) as well as some methods for solving differential inclusions. Some applications of differential inclusions in optimal control are also considered.
Teaching Methods: Lectures, seminars, homeworks, consultations.
Requirements/Prerequisites: Basic knowledge in Mathematical Analysis and Differential Equations.
Assessment: written final exam.
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

Basic Titles
1. V. I. Blagodatskih, A. F. Filippov. Differential Inclusions and Optimal Control, Transactions of the Mathematics Institute, Acad. Sci. USSR, 1985, vol. 169 (in Russian).
2. V. A. Plotnikov, A. V. Plotnikov, A. N. Vitjuk. Differential Inclusions with Multivalued Right-Hand Side, AstroPrint, Odessa, 1999 (in Russian).
3. T. R. Gichev. Optimal Control, part 1, Sofia University Publishing House, Sofia, 1980 (in Bulgarian).

Additional Titles
1. A. V. Arsirii, O. D. Kichmarenko, N. V. Skripnik. Multivalued Analysis and Linear Control Problems, AstroPrint, Odessa, 2008 (in Russian).
2. T. R. Gichev. Optimal Control, part 2, Sofia University Publishing House, Sofia, 1981 (in Bulgarian).

Abbreviation:
FS: Fall Semester
SS: Spring Semester

UNIFORM DISTRIBUTION OF SEQUENCES

Semester: 8 semester
Course Type: Lectures and seminars
Hours per week: 2 lecture hours + 1 seminar hour per week / SS
ECTS credits: 4.5 credits
Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Short Description: The main topics to be considered:
- Criterions for uniformly distribution
- Discrepancy and Diaphony
- Low discrepancy sequences and nets
- Numerical integration and applications.

Course Aims: This course develops in details notions and theorems of the described scientific problems.
Teaching Methods: Lectures, tutorials, homework, problem-solving tests. During the lectures students are acquainted with the basic theoretical material- definitions, theorems, applications, with the methods of theorems proofs. During seminars students solve practical problems. The knowledge obtained within the theoretical practice is used and it is also used in the process of problem solving.
Requirements/Prerequisites: Basic knowledge of courses in mathematical analysis, theory of the probability, theory of numbers and others.
Assessment: written exam on seminars and discussion on the theoretical material from the lectures.
Registration for the course: by request at the end of the current semester.
Registration for the exam: Students and the lecturer agree on the convenient dates within the announced calendar schedule of examination session.

References
Basic Titles
1. L. Kuipers, H. Niederreiter, Uniform Distribution of Sequences, John Wiley & **S**ons, New York, London, Sydney, Toronto, 1974.
Additional Titles
1. Papers on different subjects.

Abbreviation
SS: Spring Semester
FS: Fall Semester

INTRODUCTION TO CRYPTOGRAPHY

Semester: 8-th semester
Course Type: Lectures and seminars
Hours per week: 2 lecture hours + 1 seminar hour per week / SS
ECTS credits: 4.5 credits
Department: Department of Informatics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.
Course Status: Optional course in the B.S. Curriculum of Mathematics.
Course description: The course introduce basic concepts of cryptography – cryptographic system, encryption and decryption keys, classic crypto attacks. In part symmetrical cryptography is considered the basic blocks and stream codes. Consider the necessary basis of number theory and discuss the basic tasks of asymmetric cryptography. Presented are modern asymmetric cryptographic systems, electronic signature and key exchange.
Scope of the course: Obtaining knowledge of the theoretical backgrounds and practical abilities for applications of the Cryptography. Development of abilities for work with concrete cryptographic systems, to underline the basic strengths and weaknesses, as well as methods of crypto attacks.
Teaching Methods: lectures, discussions, practical exercises
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. Bruce Schneier, Applied Cryptography, 2-nd ed, Wiley, 1996, ISBN 0-471-11709-9.
2. J. Menezes, P. C. van Oorschot, S. A. Vanstone, Handbook of Applied Cryptography, 1996, ISBN 0-8493-8523-7
3. Douglas Stinson, Cryptography: Theory and Practice, 2005, ISBN 1-58488-508-4.
4. Lecture Notes.

GENERATING FUNCTIONS

Semester: 8 semester

Course Type: Lectures

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

ECTS credits: 4.5 credits

Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.

Course Status: Optional course in the B.S. Curriculum of Mathematics.

Course Objectives: Students should obtain knowledge about basic results and methods of the theory of generating functions and some of its applications in Combinatorics, Algebra, Number Theory, etc.

Requirements/Prerequisites: Basic knowledge in Mathematical Analysis. Knowledge in Linear Algebra, Higher Algebra and Combinatorics is an advantage.

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

Basic Titles

1. H. S. Generatingfunctionology, 3rd ed., Wellesley, MA: A K Peters., 2006. http://www.math.upenn.edu/~wilf/gfology2.pdf.
2. M. Hall, Jr., Combinatorial Theory, Reprint of the 2nd ed. Wiley Classics Library. Chichester: John Wiley & Sons., 1998.
3. S. K. Lando, Lectures on Generating Functions, Transl. from Russian by the author, Student Mathematical Library. 23. Providence, RI: American Mathematical Society (AMS), 2003.

Abbreviation:

FS: Fall Semester

SS: Spring Semester

COMBINATORIAL RING THEORY

Semester: 8-th semester

Course Type: Lectures

Hours per week: 3 lecture hours per week / SS

ECTS credits: 4.5 credits

Department: Department of Mathematics and Physics, Faculty of Mathematics and Natural Sciences, South-West University "Neofit Rilski" – Blagoevgrad.

Course Status: Optional course in the B.S. Curriculum of Mathematics.

Short Description: Combinatorial theory of the Rings is an area of modern algebra, which is extremely active in the second half of the XX century and in which many people work today both

in Bulgaria and in many famous mathematical centers abroad. The theory has applications in many other mathematical disciplines, as well as in other areas of natural sciences - theoretical physics, chemistry.

Course Aims: The purpose of this course is to introduce students to the basic theory of combinatorial ring theory and its applications to computer algebra. The content of the course gives the students the opportunity to be able to follow other courses that use this theory as well as to read articles and books in this field.

Teaching Methods: lectures, homework, and problem solving tests.

Requirements/Prerequisites: The students should have basics knowledge from Algebra.

Assessment: permanent control during the semester including homework and two written exams, and written exam in the semester's end on topics from lectures.

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. W. W. Adams, P. Loustaunau, An Introduction to Grőbner Bases, Graduate Studies in Math. 3, AMS, Providence, R.I., 1994.
2. T. A. Springer, Invariant Theory, Lect. Notes in Math. 585, Springer-Verlag, 1977.
3. V. A. Ufnarovsky, Combinatorial and asymptotic methods in algebra, in: A. I. Kostrikin, I. R. Shafarevich (Eds.), "Algebra VI", Encyclopaedia of Mathematical Sciences 57, Springer-Verlag, 1995, 1-196.
4. G. R. Krause, T. H. Lenegan, Growth of Algebras and Gelfand-Kirillov Dimension, Pitman Publ., London, 1985 (Second edition by AMS).
5. I. N. Herstein, Noncommutative Rings, Carus Math. Monographs 15, Wiley and Sons, Inc., New York, 1968.
6. V. Drensky, Free Algebras and PI-Algebras, Springer, Singapore, 1999.

Abbreviation:

FS: Fall Semester

SS: Spring Semester

PROJECT MANAGEMENT

Semester: 8 semester

Course Type: lectures and seminars

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

ECTS credits: 4.5 credits

Department: Philosophy

Course Status: Optional course in the B.S. Curriculum of Mathematics.

Short Description: The discipline "Project Management" is an elective and has significant practical value in the course of study in the specialty. In the modern socio-economic environment, the skills to provide targeted funds for financing valuable ideas are becoming a key condition for successful professional realization. The theoretical part of the course examines in a logical sequence various activities from the emergence of the project idea to reporting on the implementation and analysis of the results. The practical part provides opportunities for students to familiarize themselves (independently or under the guidance of the teacher) with project documentation and the main elements of the application form. During the seminar exercises, skills are built for developing: appropriate formulations for the project title, objectives and expected results; detailed justification of the main intentions; identification of target groups;

adequate structuring of activities with a realistic plan and schedule for implementation; means, methods and procedures for monitoring and evaluation; plan for dissemination of results and public relations; financial plan and program for ensuring sustainability. Extracurricular activities in the discipline include: studying the lecture material; independent research of donor programs and competition documents; consultations, homework, library work, preparation for tests, etc.

Course Aims: The aim of the course "Project Management" is to introduce specialists to the specifics of project activities and to familiarize them with the main stages of project development and management. Among the main expected results are: formed skills and developed abilities to search for funding opportunities within programs and organizations; gathering the necessary information and documentation for the development of a quality project proposal; identifying the needs of the specific definition of target groups; formulating clear, realistic and achievable goals; developing convincing justifications for the main project intentions; organizing adequate project activities in a realistic plan and schedule; developing an optimal financial plan for implementation; appropriate mechanisms for creating, monitoring and evaluating project activities; compiling an effective plan for testing and disseminating results; designing a sustainability strategy.

Teaching Methods: Practical exercises are held in the seminar rooms of the department, equipped with the necessary equipment for conducting a full-fledged educational process - a mobile computer, a multimedia projector, an Internet connection. The application of interactive teaching methods is envisaged, mainly using discussion methods - conversation, discussion, deliberation; situational methods - a method of specific situations, solving cases regarding various organizational and management problems, simulation of real problems in the implementation of the project and making specific organizational and administrative decisions; methods for discussing and solving specific practical tasks and conducting a comparative analysis between different options in the development and implementation of individual project elements, etc. A thorough argumentation of each thesis, position or idea is required when discussing and solving the added practical organizational and management tasks. Each student is given different data and information for the solution of one or another case from a real or introduced project. After each topic of the teaching material provided for exercises, students prepare a short text containing a proposal for solving the assigned task, accompanied by a brief justification.

Assessment: The student exam is written. It consists of the development of two theoretical questions from the course syllabus.

Registration for the course: by request at the end of the current semester.

Registration for the exam: Students and the lecturer agree on the convenient dates within the announced calendar schedule of examination session.

References

Basic Titles

1. Nadia Marinova. Project Management – A Tool for Achieving Sustainable Development, New Bulgarian University, Sofia, 2013 (in Bulgarian).
2. A Knowledge System Guide for Project Management (PMBOK Guide), Classics and Style, 2011 (in Bulgarian).
3. Journal “Funds. Programs. Projects. Development, Financing, Management”, Personal Consult (in Bulgarian).
4. Anastasia Stancheva. Project Management, Steno, 2009 (in Bulgarian).
5. Project Management Handbook, Harvard Business Review, 2008.
6. Penka Kozhuharova, Yanka Totseva. Development and Management of Educational Projects, Ciela, Sofia, 2008 (in Bulgarian).

7. Ruslan Penchev. Project Management, New Bulgarian University, Sofia, 2008 (in Bulgarian).

Additional Titles

1. Maria Mateeva. Development of Management of Projects and Programs of the European Union, EuroConsult 06, 2007 (in Bulgarian).
2. Ken Bradley. Understanding PRINCE 2, SPOCE Project Management Ltd., 2007.
3. Mary Grece Duffy. Pocket Mentor: Managing Projects, 2006.
4. Peter Simon. Practical Project Risk Management.
5. Alexander Apostolov. Developing the Sustainable Development Projects, Projecta, 2006 (in Bulgarian).
6. Ognian Andreev. Project Management, SoftTrade, 2006 (in Bulgarian).
7. Tzako Panteleev. Project Interventions in Education, Sibi, 2005 (in Bulgarian).
8. Celia Burton, Norma Michael. A Practical Guide to Project Planning, 1994.