SOUTH-WEST UNIVERSITY „NEOFIT RILSKI“
2700 Blagoevgrad, 66 Ivan Michailov str.
e-mail: info@swu.bg
http://www.swu.bg

INFORMATION PACKAGE

/ECTS/

FIELD OF HIGHER EDUCATION: **4. NATURAL SCIENCES, MATHEMATICS AND INFORMATICS**

PROFESSIONAL FIELD: **4.1 PHYSICS SCIENCES**

MASTER PROGRAMME: **NUCLEAR AND PARTICLE PHYSICS**

QUALIFICATION CHARACTERIZATION

OF MASTER PROGRAMME: **NUCLEAR AND PARTICLE PHYSICS**

EDUCATIONAL AND QUALIFICATION DEGREE: **MASTER**

PROFESSIONAL QUALIFICATION: **PHYSICIST, NUCLEAR AND PARTICLE PHYSICS**

DURATION: **2 YEARS (4 SEMESTERS)**

FORM OF TRAINING: **REGULAR**

The Master's program in “Nuclear and Particle Physics” with a study period of 4 semesters is intended for students with an acquired educational and qualification degree “*Bachelor*”/ “*Master*” in specialties in other professional fields from the field of *Natural Sciences, Mathematics and Informatics* and the field of *Technical Sciences*.

Students who graduate from the master program “Nuclear and Particle Physics” acquire fundamental and specialized knowledge in the area of physical problems of atomic and nuclear physics, theory of the atomic nucleus, particle physics, relativistic physics, cosmic rays, nuclear reactions, etc. During their studies the students acquire also theoretical and applied knowledge and skills in informatics and information technologies.

The master program in “Nuclear and Particle Physics” prepares for work in laboratories and research institutions (in relation to physics, chemistry, biology, geology) that use physical methods of atomic and nuclear physics as well as in particle physics. The master degree allows the graduates to be employed as specialists in research organizations, physicist, chief of laboratory, researcher, assistant professor and lecturer in higher schools after an admission examination.

CURRICULUM

(Adopted in 2014, updated 2021)

First year

First semester	ECTS credits	Second semester	ECTS credits
Obligatory disciplines		***Obligatory disciplines***	
Applied mathematics	5	Fundamentals of the computer technique and technologies	6
Mathematical methods of physics	5		
Mechanics	5	Molecular physics	6
Electricity and magnetism	5	Optics	6
Atomic physics	5	Nuclear physics	6
Astronomy and astrophysics	5	Theoretical physics	6
	Total 30		Total 30

Second year

Third semester	ECTS credits	Fourth semester	ECTS credits
Obligatory disciplines		***Obligatory disciplines***	
Theory of atomic nuclei	6	Elective discipline group II	5
Particle physics	6	Elective discipline group II	5
Elective discipline group I	6	Elective discipline group II	5
Elective discipline group I	6		
Elective discipline group I	6	State graduation examination in physics or Diploma theses	15
Elective disciplines group I		***Elective disciplines group II***	
Contemporary models of the atomic nucleus		Experimental methods of nuclear physics	
Nuclear reactions with heavy ions		Nuclear reactions with neutrons and photons	
Modern computer technologies		Relativistic nuclear physics	
Visual programming		Electron and ion methods for material analysis	
Quantum physics		Radiation of charged particles	
Radiation biophysics		Physics of cosmic rays	
	Total 30		Total 30

TOTAL FOR TWO YEARS: 120 CREDITS

DESCRIPTIONS OF THE COURSES

APPLIED MATHEMATICS

ECTS credits: 5 credits
Hours per week: 2 lecture hours, 2 tutorial hours per week
Assessment method: Examination
Course Status: Obligatory
Semester: I
Department: Informatics

Course Description: The course includes:

- basic **numerical methods** of Mathematical Analysis (approximation of functions by interpolation and the least suqres data fitting, numerical differentiation, numerical quadrature), of Algebra (solving nonlinear equations and systems of linear equations) and of Ordinary Differential equations (Cauchy problem for ordinary differential equations of I order and boundary problem for ordinary differential equations of order II);
- basic concepts and results of combinatorics and **Theory of Probability** (random events, probability, random variables, probability distributions, basic characteristics of random variables, basic results of theory of probability).

Course Objectives: Students should obtain basic knowledge about numerical methods and theory of probability and mathematical statistics.
Teaching Methods: lectures, tutorials 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 the lecturer and Student Service Department

MATHEMATICAL METHODS IN PHYSICS

ECTS credits: 5.0
Hours per week: 2 Lectures + 2 Seminar
Assessment: exam
Course Status: Obligatory course
Semester: I
Department of Mathematics and Physics
Faculty: Natural Sciences & Mathematics

Specific Goals of the Course: the course aims at introducing some of the aspects of the theory of partial differential equations and the basis of vector and tensor analysis. The course focuses on physical aspect of basic mathematical notions and methods for the solving of important types of problems in order to clarify the possibility to practically apply the knowledge acquired in the course.

Short Description: Main topics to be considered:

- First degree partial differential equations
- Linear second degree partial differential equations from hyperbolic, parabolic and elliptic kind
- Wave equation, heat equation, Laplac's and Poisson's equations

- Vector and Tensor Analysis

Pedagogical Methods and Assessment: The course includes lectures, seminars, consultations, course assignments and tests. Evaluation is made on the basis of term and final tests based on the contents of the lectures and the seminars. Only students who have positive evaluation mark on the term tests are allowed to take the final test. The students with high term evaluation marks varying between 5.00 and 5.50 only have to take theoretical exam, those who have term evaluation mark between 5.50 - 6.00 do not have to take the final exam and are given an excellent final mark for the course. The course grade (CG) is only assigned to students who have passed successfully and with a positive marks both their term and final tests. The final course grade is calculated with the help of the following formula:

CG = 0.6 X Term test results + 0.4 X Final test result

MECHANICS

ECTS credits: 5.0
Hours per week: 2 Lectures + 1 Sem. + 1 Lab.
Assessment: exam
Course Status: Obligatory course
Semester: I
Department of Mathematics and Physics
Faculty: Natural Sciences & Mathematics

Subject Description: The course considers classical mechanics phenomena. It starts with kinematics and dynamics of point particle and system of point particles. The Newtonian principles of dynamics are considered in details. Particular attention is paid to motion in inertial and noninertial frames of reference, laws of conservation of energy and momentum, gravitation, such phenomena as mechanics harmonic oscillatory motions and waves. In addition the basic principles of the special theory of relatively and fluids mechanics are present.

Specific Goals of the Subject: The university course “Mechanics” is aimed to ensure basic knowledge on mechanics phenomena as a foundation of the physics. Receiving this grounding the students are getting ready for others special courses studying during the next years. Laboratory classes give the students practical skills for physics observations.

Pedagogical Methods: Lectures are visualized by demonstrations. During the seminar classes students solve varied problems on optics. Parts of topics with practical importance are directed to the laboratory classes.

Preliminary Requirements: Basic knowledge in Physics and Mathematics.

Subsidiary Materials: Educational literature on General and Applied Physics and printed materials on the topics given by lecturer.

Evaluation Method: Written examination and additional conversation with the lecturer upon course topics. Some intermediate tests conduct through the semester.

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

ELECTRICITY AND MAGNETISM

ECTS credits: 5.0
Hours per week: 2 Lec/ 1 Sem/ 1 Lab
Assessment: exam
Course Status: Obligatory course
Semester: I
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66, Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Mathematics and Physics

Subject Description: The course considers the general laws of electrical and magnetic phenomena. The first part studies basic laws of electrical phenomena such as electromotive force, electric fields, electrical potential, Gauss law, dielectrics and metals in electrical field, conductors, and electrical current. The second part considers magnetic phenomena and includes field of moving charge, electrical dipole, magnetic forces, electromagnetic induction, and magnetic properties of mater. The third section concern questions of movement of the electrical parts in electric and magnetic fields.

Specific Goals of the Subject: Students acquire knowledge about Electromagnetism, Optics, Quantum Mechanics, Modern Atomic and Nuclear Physics. Material is selected depending of the specificity of the speciality. For that reason some specific topics are presented in details. Parts of topics with practical importance are directed to the laboratory classes.

Pedagogical Methods: Lectures are visualized by demonstrations and laboratory tasks performance during the laboratory classes. From methods point of view teaching material is grouped in sections following logical consistency of the cause.

Preliminary Requirements: Basic knowledge in Physics and Mathematics.

Subsidiary Materials: Educational literature on General and Applied Physics and printed materials on the topics given by lecturer.
Evaluation Method: Final examination in written form and subsequent conversation with the lecturer. Some intermediate tests conduct through the semester.

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

ATOMIC PHYSICS

Semester:1 semester
Cours Tipe: Lectures, seminars and laboratory exercises
Hours per week/FS/SS: 2 lecture hours, 1 seminar hour and 1 laboratory hour per week/SS
ECTS credits: 5 credits
Status of the Subject: Compulsory course
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66 Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Mathematics and Physics

Subject Description: Introduction to Atomic and Molecular Physics. Structure of the Atom. The Bohr Model. Atomic Orbitals. Hydrogen Atom. One and Two Electron Atoms. Interaction of Atoms with Electromagnetic Radiation, External Electric and Magnetic Fields. Fine and Hyperfine Structure. Xray Spectra. Zeeman Effect. Balmer Series. Photoelectric Effects. The Periodic Table. The Nature of Chemical Bonds. Molecular Geometry. Intermolecular Interactions.

Specific Goals of the Subject: Students acquire basic knowledges required about Atomic and Molecular Physics. Material is selected depending of the specificity of the speciality. For that reason some specific topics are presented which are not included in the Physics programme for non-physical students.

Teaching Methods: Lectures are visualised by demonstrations and laboratory tasks performance during the laboratory classes. Exercises and case studies are decided at seminars. From methods point of view teaching material is grouped in sections by logical consistency from Structure of Atoms and Atomic Models via Interaction of Atoms with External Electric and Magnetic Fields to Fine and Hyperfine Structure and the nature of Chemical Bonds. Practical topics are directed to the laboratory classes.

Requirements/Prerequisites: in General Physics and Maths.

Evaluation Method: Evaluation defined by a written exam and current control of the laboratory and seminar exercises taken certain gravity. Some intermediate tests conduct through the semester.

Registration for the course: Not necessary.

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

ASTRONOMY AND ASTROPHYSICS

ECTS credits: 5,0
Weekly workload: 2 + 1 + 0
Form of assessment: Written exam
Statute of the course: Compulsory
Semester: 1

Departments involved: Department of Mathematics and Physics, Faculty of Natural Sciences and Mathematics

Annotation: The course "Astronomy and Astrophysics" is included as compulsory course in the specialty curriculum. The course "Astronomy and Astrophysics" is with total workload 45 hours, which includes 30 hours lectures and 15 hours seminars. The students' self-study is 105 hours.

Teaching on the course "Astronomy and Astrophysics" has theoretic-applied character.

Current control of the students' educational achievements is carried out during the semester in the hours for seminars. Teaching on the course ends with a written exam.

Course content:

1. Astronomy and astrophysics as science.
2. Visible positions and movements of the celestial objects.
3. Sun. Movement of the Sun.
4. Solar system.
5. Moon. Movement of the Moon.
6. Astronomical methods for measuring the time.
7. Stars. Stellar evolution.
8. Interstellar medium.
9. Galaxies and Universe.
10. Milky Way Galaxy.
11. Fundamentals of the contemporary astrophysics.
12. Methods and instruments of the astrophysics.

13. Astrodynamics.

Teaching methods and evaluation: Lectures are held in a lecture hall, that is equipped with the necessary technique – computer and multimedia projector, using the computer presentations, which are developed in accordance with the educational content of the lectures.

To conduct the seminars are used variety of didactic materials – computer presentations, electronic visual materials, tasks and other.

Certification of the semester get students who have received an evaluation of the current control at least “Satisfied 3” (D).

Teaching on the course “Astronomy and Astrophysics” ends with a written exam on the educational content. A final evaluation is formed only if the student has received an evaluation of the written exam at least “Satisfied 3” (D). In forming of the final evaluation are reported the evaluations from the written exam (40 %) and from the current control (60 %).

FUNDAMENTALS OF THE COMPUTER TECHNIQUE AND TECHNOLOGIES

ECTS credits: 6 **Weekly workload:** 2 + 0 + 2
Form of assessment: Current assessment **Statute of the course:** Compulsory
Semester: II

Departments involved: Department of Mathematics and Physics, Faculty of Natural Sciences and Mathematics

Annotation: The course “Fundamentals of the Computer Technique and Technologies” is included as compulsory course in the specialty curriculum. Teaching on the course “Fundamentals of the Computer Technique and Technologies” has theoretic-applied character.

Current control of the students' educational achievements is carried out during the semester in the hours of laboratory exercises.

Course content:

1. Introduction to databases.
2. Introduction to Microsoft Office Access 2010. Creating databases.
3. Creating tables in databases.
4. Data input in tables of databases.
5. Providing and maintaining the data integrity in databases.
6. Creating links between tables in databases.
7. Creating queries in databases.
8. Creating forms in databases.
9. Creating controls in forms and subforms to the forms in databases.
10. Creating reports in databases.
11. Creating macros in databases.
12. Creating switchboard in databases.
13. Creating indexes in tables of databases.
14. Application of the databases.

Teaching methods and evaluation: To conduct the laboratory exercises is used the material base of the department of Physics (computer laboratory). The laboratory exercises are conducted in groups. Each student has workplace. Students work individually and they perform the practical tasks, which are described in the methodological guidelines and discussed in advance with the assistant. The laboratory exercise is considered done after presentation and defense of the performance of assigned tasks.

Certification of the semester get students who have done all laboratory exercises and who have received an evaluation of the current control at least “Satisfied 3” (D).

Teaching on the course “Fundamentals of the Computer Technique and Technologies” ends with a written exam.

MOLECULAR PHYSICS

ECTS credits: 6.0
Hours per week: 2 Lectures + 1 Sem. + 1 Lab.
Assessment: exam
Course Status: Obligatory course
Semester: II
Departments involved:
Department of Mathematics and Physics,
Faculty of Natural Sciences and Mathematics

Subject Description: The course is basic in the physical education and has two parts in the general physics – thermodynamics and molecular physics. They continues one semester and ends with an examination. The course combines the fondation of the reversible thermodynamics, statistical and thermodynamical treatment of its basic values, surface tension, viscosity difusion, physical acustics and elements of nonreversible thermodynamics.

Specific Goals of the Subject: The course gives to the students minimal knowledge required about the basic macroscopic physical phenomena in the region of the thermodynamics and molecular physics. The pracrical appliation of the knowledges is the object of treatment in the seminars and laboratory.

Pedagogical Methods: Lectures visualized by physical demonstrations, seminars with decision of physical problems, laboratory classes. Some of the lectures are in a multimedia form.

Preliniuary Requirements: Basic Knowledge in mathematical analysis.

Subsidiary Materials: Educational literature on general physics (parts molecular physics and thermodynamics), printed materials on the some topics, given wy the lectures to the students.

Evaluation Methods: Every part ends with written and oral examination. The results from the test examination during lectures, seminars and laboratory take place in the full evaluation.

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

Note: The lecture course is convenient for Students of Physical, Chemistry and other natural and technical sciences.

OPTICS

ECTS credits: 6.0
Hours per week: 2 Lec/ 1 Sem/ 1 Lab
Assessment: exam
Course Status: Obligatory course
Semester: II

University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66, Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Mathematics and Physics

Subject Description: The course considers optics phenomena on the base of theory of electromagnetic wave propagation. It starts with Maxwell's equations and describes the general properties of the light waves. Particular attention is paid to such phenomena as refraction on the dielectric and metal surface, total internal refraction. Important part of the course is the consideration of the interference and the diffraction of the light, some types of interferometers and principles of the working of diffractive gratings. In addition the basic principles of geometric optics are present**.**

Specific Goals of the Subject: Students acquire knowledge about general phenomena and laws of light wave propagation. The course gives a base for others special courses such as Quantum electronics and Optical communication.

Pedagogical Methods: Lectures are visualized by demonstrations. During the seminar classes students solve varied problems on optics. Parts of topics with practical importance are directed to the laboratory classes.

Preliminary Requirements: Basic knowledge in Physics and Mathematics.

Subsidiary Materials: Educational literature on General and Applied Physics and printed materials on the topics given by lecturer.

Evaluation Method: Written examination and additional conversation with the lecturer upon course topics. Some intermediate tests conduct through the semester.

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

Note: The lecture course is suitable for students of all natural and technical sciences.

NUCLEAR PHYSICS

Semester: II
Type of presentation: Lectures / Laboratory classes
Hours per week / AS / SS: 2 Lecture hours / 1 Seminar hour /1 Laboratory hour / SS
ECTS credits: 6
Department: Mathematics and Physics Department
Course Status: Compulsory course

Short Description: Basic concepts of Nuclear Physics. Nuclear structure. Nuclear models. Nuclear Forces. Isotopic Spin. Parity Violation. Nuclear reactions. Fission. Fusion. Scattering theory. Neutron Physics. Accelerators. Nuclear reactors. Radiation α, β and γ. Basic concepts of Radiation Safety. Elementary particles.

Course Aims: The students acquire basic knowledges required about Nuclear Physics. Material is selected depending of the specificity of the speciality. For that reason some specific topics are presented which are not included in the Physics programme for nonphysical students.

Teaching Methods: The lectures are visualised by demonstrations and laboratory tasks performance during the laboratory classes. Exercises and case studies are decided at seminars. From methods point of view teaching material is grouped in sections by logical consistency from Structure of Nuclei and Nuclear Models via Nuclear reactions, Neutron Physics to Radiation and Radiation Safety.

Requirements / Prerequisites: Basic knowledge in General Physics and Mathematics.

Evaluation Method: Evaluation defined by a written exam and current control of the seminar exercises taken certain gravity. Some intermediate tests conduct through the semester.

Registration for the course: Not necessary.

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

THEORETICAL PHYSICS

Semester: 2 semester
Cours Tipe: Lectures and tutorials
Hours per week/FS/SS: 2 lecture hours, 1 tutorial hours per week/SS
ECTS credits: 6 credits
Department: Department of Physics
Course Status: Obligatory course

Short Description: The course deals with standard material of theoretical physics from the following areas: mechanics, electrodynamics, quantum mechanics, statistical physics and thermodynamics but adapted to students with a serious mathematical background who have not graduated a bachelor course in physics.

Course Aims: The course aims at giving fundamentals knowledge in theoretical Physics and to serve as a foundation for courses in theoretical physics, quantum electronics, astrophysics and other special courses.

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

Requirements/Prerequisites: General knowledge in mathematical Analysis

Assessment Current evaluation at seminars and final written examination with discussion upon the end of the course.

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

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

THEORY OF ATOMIC NUCLEI

ECTS credits: 6 credits
Assessment method: Examination
Semester: III
Hours per week: 2 lecture hours, 2 laboratory hours
Course Status: Obligatory

Methodical leadership:
Department of Mathematics and Physics,

Faculty of Mathematics and Natural Sciences

Annotation: Basic concepts of Nuclear Physics. Nuclear structure. Nuclear models. Peculiaritys of Nuclear Forces. Isotopic Spin. Investigation Methods of Atomic Nuclei. Basic concepts of Radiation Safety.

Course Aims: The students acquire basic knowledges required about Nuclear and Neutron Physics and Radiation Safety. Material is selected depending of the specificity of the speciality. For that reason some specific topics are presented which are not included in the Physics programme for non-Physical subjects.

Teaching Methods: The lectures are visualised by demonstrations and laboratory tasks performance during the laboratory classes. From methods point of view teaching material is grouped in sections by logical consistency from Structure of Nuclei and Nuclear Models via Nuclear reactions, Neutron Physics to Radiation and Radiation Safety. Parts of topics with practical importance are directed to the laboratory classes.

Evaluation Method: Assessment determined by a written exam and by ongoing control of exercises taken with a certain weight.

PARTICLE PHYSICS

ECTS credits: 6 credits
Hours per week: 2 lecture hours, 2 laboratory hours
Assessment method: Examination
Course Status: Obligatory
Semester: III

Methodical leadership:
Department of Mathematics and Physics,
Faculty of Mathematics and Natural Sciences

Annotation: The discipline "Particle physics" is compulsory for the specialty. The main objective of the course is to acquire knowledge about basic properties and interactions of elementary particles, experimental techniques in particle physics.

Course Aims: The aim of the course is to acquaint students with the basic processes in elementary particle physics, experimental methods and existing particle detectors.

Pedagogical Methods: Lectures, laboratory, homework, tutorials

Preliminary Requirements: Basic knowledge in Atomic and Nuclear Physics.

Subsidiary Materials: Educational literature on Particle Physics.

Evaluation Method: Written examination. Some intermediate tests conduct through the semester.

Registration for the course: Not necessary.

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

CONTEMPORARY MODELS OF THE ATOMIC NUCLEUS

Cours Tipe: Lectures and laboratory exercises
Hours per week/FS/SS: 2 lecture hours, 2 laboratory exercises hours per week/FS
ECTS credits: 6 credits

Methodical leadership:
Department of Mathematics and Physics,
Faculty of Mathematics and Natural Sciences

Status of the Subject: Elective course

Subject Description: The discipline contains materials from fundamental nuclear models, nucleon - nucleon interaction and probabilities of electromagnetic transitions.

Specific Goals of the Subject: The course aims at giving fundamental knowledge for contemporary models of the atomic nucleus and to serve as a foundation for the future worker in the fields of nuclear physics, astrophysics, accelerators and fundamental interactions.

Pedagogical Methods: Lectures, laboratory, homework, tutorials

Preliminary Requirements: Basic knowledge in Atomic and Nuclear Physics and Mathematical Calculus.

Subsidiary Materials: Educational literature on Theoretical Nuclear Physics.

Evaluation Method: Written examination. Some intermediate tests conduct through the semester.

Registration for the course: It is necessary to submit a request to Head of the Department at the end of the previous semester.

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

NUCLEAR REACTIONS WITH HEAVY IONS

Semester: 3 semester
Cours Tipe: Lectures and seminar exercises
Hours per week/FS/SS: 2 lecture hours, 2 seminar exercises hours per week/FS
ECTS credits: 6 credits

Methodical leadership:
Department of Mathematics and Physics,
Faculty of Mathematics and Natural Sciences

Status of the Subject: Elective course

Subject Description: The course considers basic principles and different mechanisms of nuclear reactions, elastic and inelastic scattering of nucleons and heavy ions reactions involving radioactive nuclei, fragmentation and others.

Specific Goals of the Subject: The course aims to give basic knowledge about the processes occurring at the reaction of atomic nuclei at low energies. These nuclear reactions are an essential

tool to study the properties of atomic nuclei, the receipt and study of exotic nuclear states synthesis of new elements and isotopes.

Pedagogical Methods: Lectures, laboratory, home work, tutorials

Preliminary Requirements: Basic knowledge in Atomic and Nuclear Physics and Mathematical Calculus.

Subsidiary Materials: Educational literature on Theoretical Nuclear Physics.

Evaluation Method: Written examination. Some intermediate tests conduct through the semester.

Registration for the course: It is necessary to submit a request to Head of the Department at the end of the previous semester.

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

MODERN COMPUTER TECHNOLOGIES

ECTS credits: 6,0
Weekly workload: 2 Lec. + 0 Sem. + 2 Lab.
Form of assessment: Written exam
Statute of the course: Elective
Semester: III

Departments involved:
Department of Mathematics and Physics,
Faculty of Mathematics and Natural Sciences

Annotation:

The course "Modern Computer Technologies" is included as elective course in the master program „Nuclear and Particle Physics".

The course "Modern Computer Technologies" is with total workload 60 hours, which includes 30 hours lectures and 30 hours laboratory exercises. The students' self-study is 120 hours.

Current control of the students' educational achievements is carried out during the semester in the hours of laboratory exercises.

Teaching on the course ends with a written exam.

Course content:

1. History and development of the computer systems and technologies.
2. Word processing applications.
3. Spreadsheets.
4. Presentations.
5. Databases.
6. Multimedia technologies.

Teaching methods and evaluation:

Lectures are held in a lecture hall, that is equipped with the necessary technique – computer and multimedia projector, using the computer presentations, which are developed in accordance with the educational content of the lectures.

To conduct the laboratory exercises is used the material base of the department of Physics (computer laboratory). The laboratory exercises are conducted in groups. Each student has workplace. Students work individually and they perform the practical tasks, which are described in the

methodological guidelines and discussed in advance with the assistant. The laboratory exercise is considered done after presentation and defense of the performance of assigned tasks.

Certification of the semester get students who have done all laboratory exercises and who have received an evaluation of the current control at least „Satisfied 3" (D).

Teaching on the course "Modern Computer Technologies" ends with a written exam on the educational content. A final evaluation is formed only if the student has received an evaluation of the written exam at least „Satisfied 3" (D). In forming of the final evaluation are reported the evaluations from the written exam (40 %) and from the current control (60 %).

VISUAL PROGRAMMING

ECTS credits: 6 credits
Hours per week: 2 lecture hours, 2 laboratory hours
Assessment method: Examination
Course Status: Obligatory
Semester: III

Departments involved:
Department of Mathematics and Physics,
Faculty of Mathematics and Natural Sciences

Description of Subject:

Programming languages (objective and visual) and different tools for dynamic visual programming technique.

Using the database in visual applications and object oriented anguaget technologies.

Delphi programming environment.

Database in Delphi.

Net and J2EE conception for developing the Web applications.

Specific goals of Subject: Students will acquire knowledge for modern software technologies and how to use this
system.

Pedagogical methods: Lectures will be visualized by tables, slides and presentations. In seminar exercises a real computer application will be observed and simple examples will be developed.

Preliminary requirements Basic knowledge in computer programming and logical mathematics.

Help Materials: Lectures disposed in Internet (Web site of department), copies of teaching materials and publications.

Assessment: Examination upon the lecture material. During the semester there are interim tests.

QUANTUM PHYSICS

Semester: 3 semester
Cours Tipe: Lectures and seminar exercises
Hours per week/FS/SS: 2 lecture hours, 2 seminar exercises hours per week/FS
ECTS credits: 6 credits

University/Faculty/Department: SWU "Neofit Rilsky"- Blagoevgrad; 66 Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Mathematics and Physics

Status of the Subject: Elective course

Subject Description: The discipline „Quantum Physics" is Elective for the major and has the task of creating a basis for learning the material by expanding the knowledge of quantum objects.

Specific Goals of the Subject: The aim of the course is for students to gain knowledge about the modern understanding of the structure of matter and to build an idea of how to describe the subatomic world with the methods of quantum physics.

Pedagogical Methods: Lectures, laboratory, home work, tutorials

Preliminary Requirements: Basic knowledge from previous courses in Differential Equations, Mathematical Methods of Physics, Quantum Mechanics, Atomic Physics, Nuclear Physics, etc.

Evaluation Method: Written examination. Some intermediate tests conduct through the semester.

Registration for the course: It is necessary to submit a request to Head of the Department at the end of the previous semester.

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

RADIATION BIOPHYSICS

Semester: III
Type of presentation: Lectures and Praxis
Hours per week AS / SS: 2 Lecture hours / 2 Praxis / AS
ECTS Credits: 6

Department: Department of Mathematics and Physics

Course Status: Elective course

Short Description: The thermodynamic approach at study of alive systems. Entropy of alive Nature. Basics of non-equilibrium Thermodynamics. Thermodynamics and information. Phase transitions. Chemical bonds. Fractal structures and scales. Biopolymer Physics. Biomembranes. Unique anomalous properties of Water. Solitons. Radioecology.

Course Aims: To acquaint the students with basic physical problems, approaches and methods at study of self-organisation of the Matter and interaction of living organisms with radiation.

Teaching Methods: Lectures and Praxis with decision of theoretical and practical tasks. From methodical point of view the material is arranged from the thermodynamic approach at study of living systems via Biopolymer Physics to the basic problems of Radioecology.

Requirements/Prerequisites: Basic knowledge on Basic knowledge on General, Atomic, Nuclear & Thermal Physics.

Evaluation Method: Assessment determined by a written exam and by ongoing control of exercises taken with a certain weight.

EXPERIMENTAL METHODS OF NUCLEAR PHYSICS

Semester: 4 semester
Cours Tipe: Lectures and laboratory exercises
Hours per week/FS/SS: 2 lecture hours, 2 laboratory exercises hours per week/SS
ECTS credits: 5 credits

University/Faculty/Department: SWU “Neofit Rilsky”- Blagoevgrad; 66 Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Mathematics and Physics

Status of the Subject: Elective course

Subject Description: The course aims to give basic knowledge about the interaction of nuclear radiation with matter, detectors of nuclear radiation and related with them nuclear-physical instrumentation, calibration, primary processing, interpretation of the spectrometric information and others.

Specific Goals of the Subject: The course aims to familiarize students with basic modern methods of nuclear spectroscopy, staging, techniques and primary data processing from nuclear-physical experiments at low energies, as and the acquisition of practical skills for their use

Pedagogical Methods: Lectures, laboratory, homework, tutorials

Preliminary Requirements: Basic knowledge in Atomic and Nuclear Physics and Mathematical Calculus.

Subsidiary Materials: Educational literature on Experimental Nuclear Physics.

Evaluation Method: Written examination. Some intermediate tests conduct through the semester.

Registration for the course: It is necessary to submit a request to Head of the Department at the end of the previous semester.

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

NUCLEAR REACTIONS WITH NEUTRONS AND PHOTONS

Semester: 4 semester
Cours Tipe: Lectures and laboratory exercises
Hours per week/FS/SS: 2 lecture hours, 2 laboratory exercises hours per week/SS
ECTS credits: 5 credits

University/Faculty/Department: SWU “Neofit Rilsky”- Blagoevgrad; 66 Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Mathematics and Physics

Status of the Subject: Elective course

Subject Description: The course “Nuclear reactions with neutrons and photons” is elective for the specialty. The program contains material from neutron physics and the interaction of photons with nuclei. Attention is paid to modern applications of neutron and photonuclear reactions in astrophysics and practical applications of nuclear reactions in the form of neutron activation and photonuclear analysis of the composition of matter.

Specific Goals of the Subject: The aim of the course is for students to acquire basic knowledge about the interactions of nuclei with neutrons and gamma quanta (photons), as well as to acquire practical skills for solving a wide range of specific tasks that occur in this discipline.

Pedagogical Methods: Lectures, laboratory, homework, tutorials

Preliminary Requirements: General knowledge in physics and theoretical physics.

Subsidiary Materials: Educational literature on Relativistic Nuclear Physics.

Evaluation Method: Written examination. Some intermediate tests conduct through the semester.

Registration for the course: It is necessary to submit a request to Head of the Department at the end of the previous semester.

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

ELECTRON AND ION METHODS FOR ANALYSIS OF MATERIALS

ECTS credits 5
Hours per week: 2 Lec./ 2 Lab.
Evaluation Method: Written examination. Some intermediate tests conduct through the semester.
Status of the Subject: Elective course
Semester: IV

University: SWU "Neofit Rilsky"-Blagoevgrad; 66, Ivan Mihailov Blvd.
Faculty: Natural Sciences & Mathematics
Department: Mathematics and Physics

Annotation: The course aims to acquaint students with the latest methods for analysis of materials based on the use of electronic and ion fluxes and to show their application in science and technology.

Subject Description: The course in Electron and Ion Methods for Analysis of Materials presents the main methods using electron and ion fluxes in order to study the characteristics of materials - both on the surface and in depth. The general principles of formation and direction of electron and ion fluxes, the interaction of charged particles with the atoms and molecules of the studied substances are considered. The electron and ion methods for studying surfaces of materials are described. X-ray photoelectron spectroscopy, scanning and transmission electron microscopy, electron Auger spectroscopy, secondary ion mass spectroscopy, etc. are considered. Attention is also paid to the in-depth analysis of materials with fast ions and electrons. Ion microprobe, Rutherford ion backscattering and analysis using nuclear reactions, diffraction of high energy electrons are considered.

Pedagogical Methods: Educational literature, lectures illustrated with demonstrations, laboratory exercises with solving practical tasks.

RELATIVISTIC NUCLEAR PHYSICS

Semester: 4 semester
Cours Tipe: Lectures and laboratory exercises
Hours per week/FS/SS: 2 lecture hours, 2 laboratory exercises hours per week/SS
ECTS credits: 5 credits

University/Faculty/Department: SWU “Neofit Rilsky”- Blagoevgrad; 66 Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Mathematics and Physics

Status of the Subject: Elective course

Subject Description: The discipline contains material from classical relativistic mechanics and electrodynamics, reviewing and extending some elements from bachelor’s education level. The discipline contains material from relativistic quantum physics such as: fundamental interactions of elementary particles and their unifications, Feinman diagrams, accelerators, and others.

Specific Goals of the Subject: The course aims at giving fundamental knowledge in classical and quantum relativistic physics and to serve as a foundation for the future worker in the fields of astrophysics, accelerators and fundamental interactions.

Pedagogical Methods: Lectures, laboratory, homework, tutorials

Preliminary Requirements: General knowledge in physics and theoretical physics.

Subsidiary Materials: Educational literature on Relativistic Nuclear Physics.

Evaluation Method: Written examination. Some intermediate tests conduct through the semester.

Registration for the course: It is necessary to submit a request to Head of the Department at the end of the previous semester.

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

RADIATION OF CHARGED PARTICLES

Semester: 4 semester
Cours Tipe: Lectures and laboratory exercises
Hours per week/FS/SS: 2 lecture hours, 2 laboratory exercises hours per week/SS
ECTS credits: 5 credits

University/Faculty/Department: SWU “Neofit Rilsky”- Blagoevgrad; 66 Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Mathematics and Physics
Status of the Subject: Elective course

Subject Description: The material is selected in accordance with the prescribed workload and within a reasonable compromise between theoretical and applied material giving priority to applied side of issues. The mathematical apparatus is commensurate with the level of preparation of students in the Master's degree. From a methodological point of view the material is divided into parts, following the logical sequence of the physical fundamentals of atomic and quantum mechanical theory of the atomic nucleus and its radioactive decay, interaction of radiation with matter and others.

Specific Goals of the Subject: The students acquire knowledges required about Atomic and Nuclear Physics. Material is selected depending of the specificity of the speciality. For that reason some specific topics are presented which are not included in the Physics programme for non-physical students.

Pedagogical Methods: Lectures, laboratory, homework, tutorials

Preliminary Requirements: General knowledge in physics and theoretical physics.

Subsidiary Materials: Educational literature on Relativistic Nuclear Physics.

Evaluation Method: Written examination. Some intermediate tests conduct through the semester.

Registration for the course: It is necessary to submit a request to Head of the Department at the end of the previous semester.

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

PHYSICS OF COSMIC RAYS

Semester: 4 semester
Cours Tipe: Lectures and laboratory exercises
Hours per week/FS/SS: 2 lecture hours, 2 laboratory exercises hours per week/FS
ECTS credits: 5 credits

University/Faculty/Department: SWU "Neofit Rilsky"- Blagoevgrad; 66 Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Mathematics and Physics

Status of the Subject: Elective course

Subject Description: The discipline "Physics of cosmic rays" is optional for the specialty. The main objective of the course is to acquaint students with the contemporary theoretical ideas about the sources, the mechanisms of acceleration and propagation of the cosmic rays, as well as the basic experimental methods of cosmic ray exploration.

Specific Goals of the Subject: The aim of the course is to acquaint students with the basic processes of cosmic radiation physics, the problems of modern astrophysics, experimental methods, existing cosmic particle detectors, electromagnetic radiation, and neutrinos and gravitational radiation.

Pedagogical Methods: Lectures, laboratory, homework, tutorials

Preliminary Requirements: Basic knowledge in Atomic and Nuclear Physics and Mathematical Calculus.

Evaluation Method: Written examination. Some intermediate tests conduct through the semester.

Registration for the course: It is necessary to submit a request to Head of the Department at the end of the previous semester.

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