SOUTH-WEST UNIVERSITY „NEOFIT RILSKI“
2700 Blagoevgrad, 66 Ivan Michailov str.
tel: +359/73/88 55 01, fax: +359/73/88 55 16
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**

SPECIALTY: **PHYSICS**

CODE: 06.52.4.10

QUALIFICATION CHARACTERIZATION

OF SPECIALTY **„PHYSICS“**

EDUCATIONAL AND QUALIFICATION DEGREE: **BACHELOR OF SCIENCE**

PROFESSIONAL QUALIFICATION: **PHYSICIST**

PERIOD OF STUDY: **4 YEARS (8 SEMESTERS)**

FORM OF TRAINING: **REGULAR**

The specialty „Physics“ with educational and qualification degree „Bachelor of science“ is a classic academic specialty with a period of 4 years training and is designed to prepare professionals of professional field Physics sciences with professional qualification Physicist, who know to apply physics in

research and wide range of applied activities. Students who have completed the degree „Bachelor“ receive theoretical and applied knowledge of basic physical and mathematical disciplines, which enables them to good professional career and opportunity to continue their education in the educational and qualification degree „Master’s degree“. The curriculum of the Bachelor’s degree is developed in accordance with the state requirements for the specialty, consistent with the European norms for the respective education's degree. The curriculum contains courses that are divided into three categories – compulsory, elective and facultative. They give students the opportunity through the choice of courses to receive theoretical and applied knowledge in modern physical fields and their application in other sciences and in manufacturing.

Purpose of the specialist

Physicists specialists are ready to work in testing laboratories, in laboratories and quality control centers, with devices and tools for automation in energetics, with laser technics and technologies, in laboratories and units in biotechnology, in the food-taste industry, in laboratories for the protection of aerosol air pollution, in experimental stations in agriculture and agroecology, in scientific institutes and laboratories in the field of physical sciences and related sciences (chemistry, biology, geology, etc.) that use physical methods.

The positions that can occupy the physicists specialists according to the National classification of occupations and positions are following: Physicist; Physicist, atomic physics; Physicist, electricity and magnetism; Physicist, electronics; Physicist, mechanics; Physicist, molecular physics; Physicist, optics; Physicist, theoretical physics; Physicist, thermodynamics; Physicist, heat physics; Physicist, physics of semiconductors; Physicist, solid state physics; Physicist, medical radiological physics; Physicist, medical sanitary physics.

Competences of the specialist

The students that are graduated the specialty Physics possess the necessary knowledge and skills to conducting experimental and theoretical research in contemporary and perspective directions of fundamental and applied physics, to work with devices and equipment for applied research, to organize complex research and manufacturing in different fields of physics, natural sciences and sectors of the economy that use physical methods.

CURRICULUM

FIELD OF STUDY: **„PHYSICS“**

(Adopted in 2008, updated 2017)

First Year			
First Semester	ECTS credits	Second Semester	ECTS credits
Compulsory Courses		***Compulsory Courses***	
Linear Algebra and Analytic Geometry	7,0	Mathematical Analysis II part	8,0
Mathematical Analysis I part	7,0	Fundamentals of the Computer	6,0
Mechanics	12,5	Technique and Technologies	
Foreign Language I	2,0	Molecular Physics and Thermodynamics	12,5
Sport	1,5	Foreign Language II	2,0
		Sport	1,5
	Total: 30		Total: 30
Second Year			
First Semester	ECTS credits	Second Semester	ECTS credits
Compulsory Courses		***Compulsory Courses***	
Electricity and Magnetism	11,5	Optics	10,0
Mathematical Methods in Physics – part I	10,0	Mathematical Methods in Physics – part II	8,5
Applied Thermotechnics	7,0	Theoretical Mechanics	7,0
Sport	1,5	Discreet Optimization	3,0
		Sport	1,5
	Total: 30		Total: 30
Third Year			
First Semester	ECTS credits	Second Semester	ECTS credits
Compulsory Courses		***Compulsory Courses***	
Atomic Physics	9,0	Nuclear Physics	8,5
Condensed Matter Physics	6,0	Optoelectronics and Optical	5,5
Electrodynamics	8,0	Communications	
Radio Physics	3,5	Quantum Mechanics	7,5
General Metrology	3,5	Astronomy and Astrophysics	5,5
		Energy Efficiency & Energy Management	3,0
	Total: 30		Total: 30
Fourth Year			
First Semester	ECTS credits	Second Semester	ECTS credits
Compulsory Courses		***Optional Courses***	
Laser Technique	6,0	***(Students choose four or five courses (20 credits) from the second group)***	
Optional Courses		**Second group**	
(Students choose four courses from the first group)		Physical Processes in Nuclear Power Stations	5,0
First group		Environmental Physics	5,0
Thermal Physics	6,0	Electromagnetic Compatibility of the	5,0
Preparing the Physical Experiment and Processing of Experimental Data	6,0	Electronic Systems for Measurement of Physical Quantities	
Measurement of Physical Quantities	6,0	Computer Methods in Physics	5,0
Modern Methods for Examination of the Aerospace and Natural Environment	6,0	Biophysics	5,0
		Safety in Extreme Situations	5,0
Acoustics	6,0	Practice in Astronomy	5,0
Physical Methods in Medicine	6,0	Practicum in Optical Technologies	3,0
Interaction of Radiation with Matter	6,0	Language Culture	2,0
Spectral Analyse	6,0		
		Graduation – written state exam in physics or defense of diploma thesis	10,0
	Total: 30		Total: 30

TOTAL FOR 4 ACADEMIC YEARS: **240 credits**

DESCRIPTIONS OF THE COURSES

Linear Algebra and Analytic Geometry

ECTS credits: 7,0
Hours per week: 2 + 2 + 0
Form of assessment: exam
Course Status: Compulsory course
Semester: I

Methodological guidance:
Department of Mathematics
Faculty of Mathematics and Natural Sciences

Lecturer:
Prof. Dr. Iliya Dimitrov Gyudzhenov
e-mail: iliadgl@swu.bg

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 quadratic forms.

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; to obtain knowledge and skills for application of the analytic apparatus for research of geometric objects.

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, Linear Algebra and Analytic Geometry. University Press, South-West University "Neofit Rilski", Blagoevgrad, 1999 /in Bulgarian/.
2. A. Borisov, Il. Guidzhenov, Il. Dimitrova. "Linear Algebra". University Press, South-West University "Neofit Rilski", Blagoevgrad, 2009 /in Bulgarian/.
3. A. Borisov. M. Kacarska. "Handbook on Linear Algebra and Analytic geometry". University Press, South-West University "Neofit Rilski", Blagoevgrad, 1996 /in Bulgarian/.
4. 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/.
5. K. Denecke, K. Todorov. "Lectures on Linear Algebra". University Press, South-West University "Neofit Rilski", Blagoevgrad, 1992 /in Bulgarian and German/.
6. M. Aslanski, B. Giurov. "Handbook on Linear Algebra". University Press, South-West University "Neofit Rilski", Blagoevgrad, 1999 /in Bulgarian/.
7. K. Dochev, D. Dimitrov. "Linear Algebra". Sofia, 1977 /in Bulgarian/.
8. D. Dimitrov. "Collections of Problems on Linear Algebra". Sofia, 1978 /in Bulgarian/.
9. A. Kurosh. "Course on Algebra". Sofia, "Nauka i izkustvo", 1967 /in Bulgarian and Russian/

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/.

Mathematical Analysis I part

ECTS credits: 7,0
Form of assessment: exam
Semester: I

Hours per week: 2 + 2 + 0
Course Status: Compulsory course

Methodological guidance:
Department of Mathematics
Faculty of Mathematics and Natural Sciences

Lecturers:
Assoc. Prof. D-r. Vassil Grozdanov
assist. prof. Dr. Anka Markovska

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: 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. V. Grozdanov, Mathematical analysis, first psrt , Publishing house “Neophit Rilsky” Blagoevgrad, 2015.
2. V. A. Ilin, V. A. Sadovnichi, B. H. Sendov, Mathematical Analysis, V. 1 and 2, Sofia, Science and Art, 1989.
3. I. Prodanov, N. Hadjivanov, I. Chobanov, Collection of problems of Differential and Integral Calculation, Sofia, Science and Art, 1976.
2. E. Varbanova, Lectures on Mathematical Analysis – I, Publishing house of Technical university Sofia, Sofia, 2009.
3. V. Grozdanov, K. Jordjev, A. Markovska, Methodological conduire for solving of problems of Mathematical Analysis – I, Publishing house “Neophit Rilsky” Blagoevgrad, 2012.

B. Additional Titles:

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

Mechanics

ECTS credits: 12.5 **Workload per week:** 3 + 1 + 3
Form of assessment: Written exam **Course Status:** Obligatory course
Semester: I

Department in charge of the education:
Department of Physics
Faculty: Natural Sciences & Mathematics

Lecturer:
Assoc. Prof. Radost Vassileva, Ph.D.
Phone: 0888 64 77 44, e-mail: r_vassileva@swu.bg

Annotation:
The university course “Mechanics” aims to provide basic knowledge in the field of mechanical phenomena that appear as foundation of physical science. In this way, students prepare for a more detailed study of the physical phenomena that are subject to specialized disciplines in the higher courses. Laboratory classes give the students practical skills for physical observations and experiment.

Course content:
The material covered in the lectures includes the following sections:
- Particle kinematics
- Particle dynamics
- Work and energy,
- Laws of conservation of energy, momentum and angular momentum
- Mechanics of rigid body
- Elastic properties of bodies
- Fluid mechanics.

Technology training and assessment:
The course ends in a written exam. During the period of education, students sit for written tests on the material covered in the seminars and defend protocols on the laboratory exercises. Their results are included in the formation of the final grade.

References:

Basic titles:

1. Максимов, М. *Основи на физиката – част I*. София, Булвест – 2000, 2010.
2. С. А. Тошев, И. Баев, М. Маринов, Л. Бончев. *Физика*. ДИ „Наука и изкуство”, София, 1987.
3. М. Надолийски, З. Пейков. *Учебник по физика*. УАСГ, София, 2011.
4. И. В. Савельев. *Курс общей физики*, том.1. „Наука”, Москва, 1988.
5. Ив. Амов. *Инженерна физика*. ВПИ – Благоевград, 1991.

Additional titles:

1. А. Детлаф, Б. Яворский. *Курс физики*. Высшая школа, Москва, 1989.
2. Фейнман Р., Р. Лейтон, М. Сэндс. *Файманови лекции по физика*, том 7. „Мир”, Москва.
3. Цв. Сарийски, Т. Мишонов. *Критични явления и преходи*. София, ДИ „Наука и изкуство”, 1988.

Foreign Language I

ECTS credits: 2,0
Hours per week: 0 + 2 + 0
Evaluation: ongoing assessment
Course status: Compulsory
Semester: I

Lecturer:
Assist. Prof. Bilyana Georgieva, PhD
bilianag@swu.bg
Department: Electrical Engineering, Electronics and Automatics
Faculty: Faculty of Engineering

Annotation:

The aim of the course „Foreign language – English" is to ensure the development of communication skills, reaching of certain phonetic, grammatical, lexical and thematic minimum, skills and habits for participation in real, communicative situations, knowledge and individual work with vocabulary. It aims to review and systematize the basic knowledge of the undergraduates and provides equal start level for the next stage of education, called "language of the programme". The choice of topics is based on their high particularly in the scientific style of speech and their unconditional structural significance and necessity of learning a foreign language. Widely used communicative exercises focus that strengthen the necessary grammatical habits and encourage students to be active speech activity in the studied subjects. The practical course is based on the thematic texts reflecting everyday student life, elementary special technical terminology on the subject and aims to stimulate the desire and motivation of students to enhance their language and consistent level – Elementary and Pre-intermediate.

Purpose of the course:

The aim of the course is to build an initial communicative competence, as the ability to understand and draw meaningful oral and written statements, in accordance with the rules of the English language to develop reading skills and comprehension of texts from everyday communication and presentation and related texts the basic terms in the specialty; develop skills in physical vocabulary can make translations of physical texts from English Into Bulgarian language using a dictionary.

Educational Methods:

Active methods are used through different exercises; based tests are made for control of the learned, translation of physical literature.

Mathematical Analysis II part

ECTS credits: 8,0
Form of assessment: exam
Semester: II

Hours per week: 2 + 2 + 0
Course Status: Compulsory course

Methodological guidance:
Department of Mathematics
Faculty of Mathematics and Natural Sciences

Lecturers:
Associete Professor Visil Grozdanov, Ph.D.
Assistant Professor Anka Markovska, Ph.D.

Course Description:
The course in Mathematical Analysis II 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 Riemanm 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 II, which is a basic mathematical discipline. This knowledge is necessary for studying, Mathematical Analysis III, Ordinary Differential Equations, Numerical Methods, Optimization.

Teaching Methods: lectures and seminars

Requirements/Prerequisites: Mathematical Analysis I

Assessment: written final exam, two problems solving tests per semester

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:
1. Yaroslav Tagamlitski – Differential Calculus, Nauka and Izkustvo Publishing House, Sofia, 1971 (in Bulgarian).
2. Yaroslav Tagamlitski – Integral Calculus, Nauka and Izkustvo Publishing House, Sofia, 1978 (in Bulgarian).
3. V. A. Ilin, V.A. Sadovnichi, B.H. Sendov – Mathematical Analysis, Vol. 1, Vol.2, Nauka and Izkustvo Publishing House, Sofia, 1989 (in Bulgarian).
4. I. Prodanov, N. Hadjiivanov – Problem book in Differential and Integral Calculus, Nauka and Izkustvo Publishing House, Sofia, 1976 (in Bulgarian).
5. E. Varbanova, Lectures on Mathematical Analysis – I, Publishing house of Technical university Sofia, Sofia, 2009.
6. V. Grozdanov, K. Jordjev, A. Markovska, Methodological conduire for solving of problems of Mathematical Analysis – I, Publishing house “Neophit Rilsky” Blagoevgrad, 2012.

Fundamentals of the Computer Technique and Technologies

ECTS credits: 6,0
Weekly workload: 0 + 0 + 3
Form of assessment: Current assessment
Statute of the discipline: Compulsory
Semester: II

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

Lecturer:
Chief Assistant Professor Gergana Kalpachka, PhD
e-mail: kalpachka@swu.bg

Annotation:

The discipline „Fundamentals of the Computer Technique and Technologies“ is included as compulsory discipline in the specialty curriculum „Physics“. It is studied from students studying at educational and qualification degree „Bachelor“.

The discipline „Fundamentals of the Computer Technique and Technologies“ is with total workload 45 hours laboratory exercises. The students’ self-study is 135 hours.

Teaching on the discipline „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 discipline „Fundamentals of the Computer Technique and Technologies“ ends with a current assessment. The current assessment is the evaluation of the current control that is conducted during the laboratory exercises.

References:

1. **Bangia, R.** Computer fundamentals and information technology. New Delhi: Firewall Media, 2008.
2. **Brookshear, G., D. Brylow.** Computer Science: An Overview (12th Edition). Boston, Pearson, 2014.
3. **Elmasri, R., S. Navathe.** Fundamentals of Database Systems. Pearson, 2015.
4. **Laplante, P.** Encyclopedia of Computer Science and Technology. CRC Press, 2016.
5. https://products.office.com/bg-bg/access

Molecular Physics and Thermodynamics

ECTS credits: 12.5
Workload per week: 3 + 1 + 3
Form of assessment: Written exam
Course Status: Obligatory course
Semester: II

Department in charge of the education:
Department of Physics
Faculty: Natural Sciences & Mathematics

Lecturers:
Assoc. Prof. Radost Vassileva,
тел.: 0888 64 77 44, e-mail: r_vassileva@swu.bg

Annotation:
The course aims to gives students a necessary minimum basic knowledge about the main macroscopic physical phenomena in the field of the thermodynamics and molecular physics. Some practical applications of this knowledge are an object of treatment in laboratory exercises and seminars.

Course content:
The main topics of the course are:

- Bases of equilibrium thermodynamics
- Thermodynamic and statistical interpretation of basic thermodynamic quantities
- Surface tension
- Variation of physical condition
- Elements of non-equilibrium thermodynamics. Transmission processes – diffusion, thermal conductivity and internal friction.

Technology training and assessment:
The course ends in a written exam. During the period of education, students sit for written tests on the material covered in the seminars and defend protocols on the laboratory exercises. Their results are included in the formation of the final grade.

References:

Basic titles:

1. Maksimov, M. Bases of Physics – Part I. Sofia, Bulvest – 2000, 2010. (in Bulgarian).
2. Gramatikov, P. Physics – I. Blagoevgrad, SWU “Neofit Rilski”, 2009. (in Bulgarian).
3. http://www.e-booksdirectory.com
   - **Joseph M. Powers. Lecture Notes on Thermodynamics –University of Notre Dame, 2010.**
   - **J. B. Tatum. Heat and Thermodynamics** , 2008.
   - **Eric Bertin. Introduction to Statistical Physics , ENS Lyon, 2010.**

Additional Titles:

1. H. Young, R. Freedman. University Physics N.Y., Addison-Wesley Publishers Co, 2000.
2. Hans Kroha. **Thermodynamics and Statistical Physics** , 2005.

Foreign Language II

ECTS credits: 2,0
Evaluation: ongoing assessment
Semester: II

Hours per week: 0 + 2 + 0
Course status: Compulsory

Lecturer:
Assist. Prof. Bilyana Georgieva, PhD
bilianag@swu.bg
Department: Electrical Engineering, Electronics and Automatics
Faculty: Faculty of Engineering

Annotation:

The aim of the course „Foreign language – English" is to ensure the development of communication skills, reaching of certain phonetic, grammatical, lexical and thematic minimum, skills and habits for participation in real, communicative situations, knowledge and individual work with vocabulary. It aims to review and systematize the basic knowledge of the undergraduates and provides equal start level for the next stage of education, called "language of the programme". The choice of topics is based on their high particularly in the scientific style of speech and their unconditional structural significance and necessity of learning a foreign language. Widely used communicative exercises focus that strengthen the necessary grammatical habits and encourage students to be active speech activity in the studied subjects. The practical course is based on the thematic texts reflecting everyday student life, elementary special technical terminology on the subject and aims to stimulate the desire and motivation of students to enhance their language and consistent level – Elementary and Pre-intermediate.

Purpose of the course:

The aim of the course is to build an initial communicative competence, as the ability to understand and draw meaningful oral and written statements, in accordance with the rules of the English language to develop reading skills and comprehension of texts from everyday communication and presentation and related texts the basic terms in the specialty; develop skills in physical vocabulary can make translations of physical texts from English Into Bulgarian language using a dictionary.

Educational Methods:

Active methods are used through different exercises; based tests are made for control of the learned, translation of physical literature.

Electricity and Magnetism

ECTS credits: 11.5
Type of presentation: 3 + 1 + 3
Evaluation Method: Written examination
Status of the Subject: Compulsory
Semester: III

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Mathematics

Lecturer:
Assoc. Prof. Luben Mihov Ivanov, Ph.D.
тел.: 0882 988 712, e-mail: mihovli@swu.bg

Annotation:
The course "Electrical and Magnetism" is compulsory for the specialty and is aimed at providing the basic preparation in the field of experimental physics and creates a foundation for learning the material taught in the basic physical disciplines in the above courses. The subject deals with the basic laws of electrical and magnetic phenomena. The practical exercises enable students to experimentally explore the basic physical phenomena and their application.

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 concerns questions of movement of the electrical parts in electric and magnetic fields.

Pedagogical methods and type of evaluation:
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. Final examination is in written form. Some intermediate tests conduct through the semester

Literature:
1. Ivanov L.M., General physics II part; N. Rilski Univ., Blagoevgrad, 2010.
2. Ivanov L.M., Electricity and magnetism; N. Rilski Univ., Blagoevgrad, 2011.
3. Lalov I. Electrical phenomena, Kl. Ohridski Univ., Sofia, 1997.
4. B. Crowell., “Electricity and Magnetism”, Wiley, 1998.

Mathematical Methods in Physics – part I

ECTS credits: 10.0
Form of assessment: Written exam
Semester: III

Workload per week: 3 + 3 + 0
Course Status: Obligatory course

Department in charge of the education
Department of Physics
Faculty: Natural Sciences & Mathematics

Lecturers:
Assoc. Prof. Radost Vassileva,
тел.: 0888 64 77 44, e-mail: r_vassileva@swu.bg

Annotation:
The course aims to give fundamental knowledge in Mathematical Physics and to serve as a foundation for courses in Theoretical Physics, Quantum Electronics, Astrophysics and other special-purpose courses.

Course content:
The course deals with material from various chapters of Mathematical Analysis:

1. Vector and Tensor Analysis.
2. Ordinary differential equations.
3. Systems of ordinary differential equations.

Technology trainingandassessment:
The course ends in a written exam which is held in two parts: problems and a written theoretical exposition. During the period of education students sit for written tests on the material covered in the seminars. Their results are included in the formation of the final grade.

References:

Basic titles:

1. Пушкаров, Д. Математични методи на физиката – част I. Благоевград, ЮЗУ „Неофит Рилски", 1993.
2. D.I.Pushkarov – "**Mathematical Methods of Physics**", Bahcesehir University, Istanbul, 2009.

Additional titles:

1. Христов, Хр. Математични методи на физиката. Наука и изкуство, 1980.
2. http://www.e-booksdirectory.com
   - Ray M. Bowen, C.-C. Wang. **Introduction to Vectors and Tensors Volume 2: Vector and Tensor Analysis**, **2008.**
   - Norbert Euler. **A First Course in Ordinary Differential Equations**, 2015.
   - Marcel B. Finan. **A Second Course in Elementary Ordinary Differential Equations** , 2006.

Applied Thermotechnics

ECTS credits: 7.0
Workload per week: 2 + 0 + 2
Evaluation Method: Written examination
Statute of the Subject: Compulsory course
Semester: III

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Maths

Lecturer:
Prof. Dr. Plamen Svetoslavov Gramatikov, M.Eng., Ph.D,
Phone: +359 887 946 199; E-mail: psgramat@swu.bg

Annotation:
The subject is a compulsory course studied by students to acquire a Bachelor degree on Physics. The students acquire basic knowledges required about Heat & Mass Transfer, Thermal power stations and Thermotechnics. 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.

Course content:
Thermal motors and machines. Organic fuels. Processes and products of combustion. Industrial and power boilers. Heat exchangers. Thermal power stations. Basics of the Building Physics. District heating. Energy efficiency and environmental protection.

Pedagogical Methods and type of evaluation:
Basic knowledge in General Physics, Mathematics and Thermal Physics are needed. Lectures are visualised by demonstrations and laboratory tasks performance during the laboratory classes. From the Methods point of view material is arranged from Thermal motors and machines via Building Physics to the Energy efficiency and environmental protection. Practical topics are directed to the laboratory classes.
The course is completed by a written examination. Some intermediate tests are conducted through the semester.

References (all in Bulgarian)**:**
1. Gramatikov P. Lectures on Applied Thermal Engineering; N. Rilski Univ., Blagoevgrad, 2012.
2. Dimitrov A. Modern heating technology and energetics; Sofia, 2011.
3. Hadjigenova N. Thermal part of TPP, Tehnika, Sofia, 1979.

Optics

ECTS credits: 10.0
Type of presentation: 3+1+3
Evaluation Method: Written examination
Status of the Subject: Compulsory
Semester: IV

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Mathematics

Lecturer:
Assoc. Prof. Luben Mihov Ivanov, Ph.D.
тел.: 0882 988 712, e-mail: mihovli@swu.bg

Annotation:
The course "Optics" is compulsory for the specialty and is aimed at providing the basic preparation in the field of experimental physics and creates a foundation for learning the material taught in the basic physical disciplines in the above courses. The subject deals with the basic laws of optical. The practical exercises enable students to experimentally explore the basic physical phenomena and their application.

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.

Pedagogical methods and type of evaluation:
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. Final examination is in written form. Some intermediate tests conduct through the semester.

Literature:
1. Ivanov L.M., General physics II part; N. Rilski Univ., Blagoevgrad, 2010.
2. Ivanov L.M., Electricity and magnetism; N. Rilski Univ., Blagoevgrad, 2011.
3. Lalov I. Electrical phenomena, Kl. Ohridski Univ., Sofia, 1997.
4. B. Crowell., "Electricity and Magnetism", Wiley, 1998.

Mathematical Methods in Physics – part II

ECTS credits: 8.5
Workload per week: 3 + 3 + 0
Form of assessment: Written exam
Course Status: Obligatory course
Semester: IV

Department in charge of the education:
Department of Physics
Faculty: Natural Sciences & Mathematics

Lecturers:
Assoc. Prof. Radost Vassileva,
тел.: 0888 64 77 44, e-mail: r_vassileva@swu.bg

Annotation:
Students should acquire:

1. The basic theoretical concepts of the studying mathematical apparatus;
2. The methods for solving of linear first-degree partial differential equations and linear second-degree partial differential equations from hyperbolic, parabolic and elliptic kind;
3. The structural elements of the mathematical modeling as a method of theoretical cognition, based on the partial differential equations;
4. The methods for integrating of analytic functions.

Course content:
The main topics in the course are:

- First degree partial differential equations
- Linear second degree partial differential equations from hyperbolic, parabolic and elliptic kind
- Wave equation, heat equation, Laplace's and Poisson's equations
- Analytic functions and applications.

Technology training and assessment:
The course ends in a written exam which is held in two parts: problems and a written theoretical exposition. During the period of education students sit for written tests on the material covered in the seminars. Their results are included in the formation of the final grade.

References:

Basic titles:

1. Пушкаров, Д. Математични методи на физиката. София, Проф. Марин Дринов, 1996.
2. Христов, Хр. Математични методи на физиката. Наука и изкуство, 1980.
3. D.I. Pushkarov – "**Mathematical Methods of Physics**", Bahcesehir University, Istanbul, 2009.

Additional titles:

1. Димитрова, К., П. Паскалев. Методическо ръководство за решаване на задачи по висша математика – трета част. Архимед, 2008.
2. http://www.e-booksdirectory.com
   - William W. Symes. **Partial Differential Equations of Mathematical Physics**, Rice University, 2006.
   - A.D.R. Choudary, Saima Parveen, Constantin Varsan. **Partial Differential Equations: An Introduction**, arXiv, 2010.
   - Marcel B. Finan**. A First Course of Partial Differential Equations in Physical Sciences and Engineering,** Arkansas Tech University, 2009.
   - Matthias Beck, Gerald Marchesi, Dennis Pixton. **A First Course in Complex Analysis**, San Francisco State University, 2007
   - W. W. L. Chen. **Introduction to Complex Analysis**, Macquarie University, 2008.

Theoretical Mechanics

ECTS credits: 7
Workload per week: 2 + 3 + 0
Evaluation Method: Written examination
Statute of the Subject: Compulsory course
Semester: IV

Methodological guidance:
Department of Physics
Faculty of Natural Sciences and Mathematics

Lecturer:
Assoc. Prof. Ralitsa Stanoeva, PhD, e-mail: rstanoeva@swu.bg

Annotation:
Students acquire knowledge about basic principles and properties of the classical mechanical phenomena. The course gives a base for others special courses such as Electrodynamics, Quantum mechanics, Atomic physics etc.

Course content:
The course considers theoretical bases of Classical Mechanics. The development follows where possible the axiomatic lines, the Newton's concepts of time and space and the variational principle in its Lagrangian and Hamiltonian forms. The equations of motions are derived from these principles. The mechanical systems of harmonic oscillator, particle in central field and solid body are considered in greater detail. A stress is put on the equations of motion, conservation laws and Galilean relativity in mechanics.

Pedagogical Methods and type of evaluation:
Lectures and seminar classes. During the seminar classes students solve varied problems on mechanical systems and their description. Parts of topics with practical importance are directed to the seminar classes. Basic knowledge in General Physics and Mathematical Calculus are needed.
The course is completed by a written examination. Some intermediate tests are conducted through the semester.

Discreet Optimization

ECTS credits: 3.0
Form of exam: Exam
Semester: IV semester

Hours per week: 2 + 1 + 0
Course Status: Obligatory course

Lecturer:
Prof. D.Sc. Ivan Mirchev
Department of Informatics, Faculty of Mathematics and Natural Sciences, 66 Ivan Michailov st. 2700 Blagoevgrad, Bulgaria
phone: 073/88 51 63, e-mail: mirchev@swu.bg
Assistant: Assist. Prof. Fatima Sapundzhi, Phd ,
Department of Communication and Computer Engineering, Faculty of Engineering, 66 Ivan Michailov st. 2700 Blagoevgrad, Bulgaria
phone: 073/8851 63, e-mail: sapundzhi@swu.bg

Annotation:
Students should obtain basic knowledge in Mathematical modeling in discrete structures and skills for solving optimization problems for graphs and networks.

Short Description:
In this course are considered some elements of the following main topics:

- Introduction in graph theory (essential concepts and definitions, modeling with graphs and networks, data structures for networks and graphs, computational complexity, heuristics).
- Tree algorithms (spanning tree algorithms, variations of the minimum spanning tree problem, branchings and arborescences).
- Shortest-path algorithms (types of shortest-path problems and algorithms, shortest-paths from a single source, all shortest-path algorithms, the k- shortest-path algorithm, other shortest-paths).
- Maximum-flow algorithms (flow-augmenting paths, maximum-flow algorithm, extensions and modifications, minimum-cost flow algorithms, dynamic flow algorithms).
- Matching and assignment algorithms (introduction and examples, maximum-cardinality matching in a bipartite graph, maximum-cardinality matching in a general graph, maximum-weight matching in a bipartite graph, the assignment problem).
- The chinest postman and related arc routing problems (Euler tours and Hamiltonian tours, the postman problem for undirected graphs, the postman problem for directed graphs).
- The traveling salesman and related vertex routing problems (Hamiltonian tours, basic properties of the traveling salesman problem, lower bounds, optimal solution techniques, heuristic algorithms for the TSP).
- Location problems (classifying location problems, center problems, median problems).
- Project networks (constructing project networks, critical path method, generalized project networks).

Teaching and assessment technology:
Teaching Methods: lectures, tutorials, individual student's work
Assessment: three homework D1, D2, D3; two tests K1 and K2 (course project); written exam
Final evaluation: = 0,2 .($\frac{\mathbf{D}1+\mathbf{D}2+\mathbf{D}3}{3}$) + 0,5 .($\frac{\mathbf{K}1+\mathbf{K}2}{2}$) + 0,3 (exam)

References:

1. Ив.Мирчев, "Графи. Оптимизационни алгоритми в мрежи", Благоевград, 2001 г.
2. Ив.Мирчев, "Математическо оптимиране", Благоевград, 2000 г.
3. Minieka, E., Optimization Algorithms for Networks and Graphs, Marcel Dekker, Inc., New York and Basel, 1978 (Майника, 3. Алгоритми оптимизации па сетях и графах, М., "Мир", 1981).
4. Christofides, N., graph Theory. An Algorithmic approach, Academic Press lnc /London/ Ltd. 1975, 1997 /Кристофидес, Н. Теория графов.Алгоритмический подход, М., "Мир", 1978/.
5. Simon Harris, James Ross, Fundamentals of Algorithms, Alex-Soft, 2006.
6. Herbert Schild, JAVA 2: Programmer's Guide, SoftPres, 2007.

Atomic Physics

ECTS credits: 9.0
Workload per week: 3 + 1 + 2
Evaluation Method: Written examination
Statute of the Subject: Compulsory course
Semester: V

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Maths

Lecturer:
Prof. Dr. Plamen Svetoslavov Gramatikov, M.Eng., Ph.D,
Phone: +359 887 946 199; E-mail: psgramat@swu.bg

Annotation:
The subject is a compulsory course studied by students to acquire a Bachelor degree on Physics. The 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. 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.

Course content:
Basic concepts and definitions in metrology. Dimension and units of physical quantities. Systems units. Accuracy and error. Measuring devices. Processing of measurement results. Categories and types of standards.

Pedagogical Methods and type of evaluation:
Basic knowledge in General Physics, Mathematics and Thermal Physics are needed. 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 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.
The course is completed by a written examination. Some intermediate tests are conducted through the semester.

References (all in Bulgarian):
1. Gramatikov P. Atomic Physics; N. Rilski Univ., Blagoevgrad, 2007.
2. Minkova A. Atomic Physics, Romina, Sofia, 2000.
3. Balabanov N., M. Mitrikov. Atomic Physics, Kl. Ohridski Univ., Sofia, 1991.

Condensed Matter Physics

ECTS credits: 6,0
Weekly workload: 3 + 0 + 1
Form of assessment: Written exam
Statute of the discipline: Compulsory
Semester: V

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

Lecturer:
Chief Assistant Professor Gergana Kalpachka, PhD
e-mail: kalpachka@swu.bg

Annotation:

The discipline „Condensed Matter Physics“ is included as compulsory discipline in the specialty curriculum „Physics“. It is studied from students studying at educational and qualification degree „Bachelor“.

The discipline „Condensed Matter Physics“ is with total workload 60 hours, which includes 45 hours lectures and 15 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 discipline ends with a written exam.

Course content:

1. Model of condensed matter. Main types condensed matter.
2. Chemical bonds. Types. Energy of chemical bond.
3. Geometric properties of the crystal lattice.
4. Defects in the crystal lattices.
5. Condition of electrons in atoms with many electrons and in the crystal.
6. Elastic properties of condensed matter.
7. Magnetic properties of condensed matter.
8. Dielectric properties of condensed matter.
9. Macroscopic polarization of solid states.
10. Optical properties of condensed matter.
11. Superconducting properties of condensed matter.

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 laboratory „Condensed Matter Physics“. The laboratory exercises are conducted in groups. Students work in subgroups of 2–3 persons at workplace and they perform the practical tasks, which are described in the methodological guidelines and discussed in advance with the assistant. After each conducted laboratory exercise students prepare protocol. The laboratory exercise is considered done after submission and defense of the relevant protocol. Certification of the semester get students who have done all laboratory exercises, who have submitted and defended the relevant protocols and who have received an evaluation of the current control at least „Satisfied 3“ (D).

Teaching on the discipline „Condensed Matter Physics“ ends with a written exam on the educational content. 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 (60 %) and from the current control (40 %).

References:

1. **Altland, A., B. Simons.** Condensed Matter Field Theory. Cambridge University Press, 2006.
2. **Chaikin, P., T. Lubensky.** Principles of Condensed Matter Physics. Cambridge University Press, 2000.
3. **Marder, M.** Condensed Matter Physics. John Wiley and Sons, 2010.
4. **Sander, L.** Advanced Condensed Matter Physics. New York, Cambridge University Press, 2009.

Electrodynamics

ECTS credits: 8
Workload per week: 2 + 3 + 0
Evaluation Method: Written examination
Statute of the Subject: Compulsory course
Semester: V

Methodological guidance:
Department of Physics
Faculty of Natural Sciences and Mathematics

Lecturer:
Assoc. Prof. Ralitsa Stanoeva, PhD, e-mail: rstanoeva@swu.bg

Annotation:
Students acquire knowledge about basic principles and properties of the classical electromagnetic field. The course gives a base for others courses such as Quantum mechanics, Atomic physics, Astrophysics.

Course content:
The course considers theoretical bases of classical electrodynamics, the main features of the special theory of relativity being studied first. This allows later apply the Lagrange variational principle to derive the Maxwell equations in their relativistic covariant form and to obtain the field invariants. The more detailed properties of the field are studied on the base of three dimensional form of Maxwell equations, considering first the free field in vacuum, then field with sources and finally field in continuous media, including the nonlinear media.

Pedagogical Methods and type of evaluation:
Lectures and seminar classes. During the seminar classes students solve varied problems on mechanical systems and their description. Parts of topics with practical importance are directed to the seminar classes. Basic knowledge in General Physics and Mathematical methods are needed.
The course is completed by a written examination. Some intermediate tests are conducted through the semester.

Radio Physics

ECTS credits: 3.5
Evaluation Method: Written examination
Semester: V

Type of presentation: 2 + 0 + 1
Status of the Subject: Compulsory

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Mathematics

Lecturer:
Assoc. Prof. Luben Mihov Ivanov, Ph.D.
тел.: 0882 988 712, e-mail: mihovli@swu.bg

Annotation:
Course "Radio physics" is compulsory for specialty and aims to provide basic training in the physics of wave processes. It is dedicated to the study of electromagnetic oscillations and resonance phenomena occurring in electrical circuits, as well as basic characteristics of electromagnetic waves.

Subject Description:
he course can be divided into two modules. The first examines electromagnetic oscillations in electrical circuits. The basic concepts and idealized elements of the electrical circuits are introduced. The processes of loss, accumulation and transformation of the electrical energy in the elements of the electric circuits during the flow of sinusoidal current are considered. Various methods for calculating circuitry have been considered. Emphasis is placed on resonance circuits, resonance of voltage and resonance currents. The second part is devoted to the study of electromagnetic waves. The properties of electromagnetic waves are based on Maxwell's theory of electromagnetic field. It is shown that flat monochromatic waves are a solution of Maxwell's equations. The main properties of the electromagnetic wave electromagnetic field electromagnetic waves and the orthogonally of the electric and magnetic vector are presented. Polarization and energy of electromagnetic waves are considered.

Pedagogical methods and type of evaluation:
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. Final examination is in written form. Some intermediate tests conduct through the semester

Literature:
1. Alfred A. Ghirardi, Radio Physics Course: An Elementary Radio Text Book for Students, Set Builders and Servicemen, Radio Design Publishing Company, California University, 2008.
2. Фархи С., С. Папазов. Теоретична електротехника, ч. 1, 2 и 3. С., Техника, 1988, 1990, 1992.
3. B. Crowell., “Electricity and Magnetism”, Wiley, 1998.

General Metrology

ECTS credits: 3.5
Workload per week: 2 + 0 + 1
Evaluation Method: Written examination
Statute of the Subject: Compulsory course
Semester: V

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Maths

Lecturer:
Prof. Dr. Plamen Svetoslavov Gramatikov, M.Eng., Ph.D,
Phone: +359 887 946 199; E-mail: psgramat@swu.bg

Annotation:
The subject is a compulsory course studied by students to acquire a Bachelor degree on Physics. The students acquire basic knowledges about basic physical concepts and definitions in metrology, the international system of units SI, basic measuring operations measurement processes, types and methods of measurement. 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.

Course content:
Basic concepts and definitions in metrology. Dimension and units of physical quantities. Systems units. Accuracy and error. Measuring devices. Processing of measurement results. Categories and types of standards.

Pedagogical Methods and type of evaluation:
Basic knowledge in General Physics, Mathematics and Thermal Physics are needed. Lectures are visualised by demonstrations and laboratory tasks performance during the laboratory classes. From the Methods point of view material is arranged from fundamentals of metrology to the need for standardization and certification of products. Practical topics are directed to the laboratory classes.
The course is completed by a written examination. Some intermediate tests are conducted through the semester.

References:
1. Electrical Measurements (ed. Matrakov BIS), TU-Sofia, 1998 (in Bulgarian).
2. Kalchev I., I. Kodjabashev, N. Kolev, I. Petrov, T. Tashev, S. Yordanova. Measurement and Instrumentation, TU-Sofia, 1998.
3. Fundamentals of metrology and electrical measurements (Ed. E.M. Dushyn), Leningrad, 1987 (in Russian).
4. Jones L., Chin A. Electronic Instruments and Measurements, Prentice-Hall Int., 1991.

Nuclear Physics

ECTS credits: 8.5
Workload per week: 3 + 1 + 2
Evaluation Method: Written examination
Statute of the Subject: Compulsory course
Semester: VI

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Maths

Lecturer:
Prof. Dr. Plamen Svetoslavov Gramatikov, M.Eng., Ph.D,
Phone: +359 887 946 199; E-mail: psgramat@swu.bg

Annotation:
The subject is a compulsory course studied by students to acquire a Bachelor degree on Physics. 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. Material is selected depending of the specificity of the speciality.

Course content:
Subject 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.

Pedagogical Methods and type of evaluation:
Basic knowledge in General Physics, Mathematics and Thermal Physics are needed. 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. Practical topics are directed to the laboratory classes.
The course is completed by a written examination. Some intermediate tests are conducted through the semester.

References:
1. Gramatikov P. Nuclear Physics with elements of Radiation Protection and Dosimetry, N. Rilski Univ., Blagoevgrad, 2008 (in Bulgarian).
2. Slavov B. Introduction in theoretical Nuclear Physics, St.. Kl. Ohridski, Sofia, 2009 (in Bulgarian).
3. Balabanov N. Nuclear Physics, Plovdiv, 1998 (in Bulgarian).
4. Rakobolyskaya Y. Nuclear Physics, Moscow Univ., 1971 (in Russian).

Optoelectronics and Optical Communications

ECTS credits: 5.5
Evaluation Method: Written examination
Semester: VI

Type of presentation: 3 + 0 + 1
Status of the Subject: Compulsory

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Mathematics

Lecturer:
Assoc. Prof. Luben Mihov Ivanov, Ph.D.
тел.: 0882 988 712, e-mail: mihovli@swu.bg

Annotation:
The course "Optoelectronics and Optical Communication Systems" examines the physical principles of optical communication system optoelectronic devices related to radiation, amplification and registration of optical impulses. The issues related to the communication capacity of the fiber optic lines and the factors limiting it are clarified.

Subject Description:
The course consists of two parts. The first part discusses the basic principles of light propagation in optical fiber lines. Consideration begins with planar waveguide as the simplest light-guide structure and continue with basic concepts such as waveguide light wave propagation, formation of waveguide's modes, step index fibers, graded index fibers, single mode fibers, intermodal dispersion, material and waveguide dispersion in single mode fibers, fiber loss, methods for fabrication and parameters control. The second part considers optical sources and transmitters including semiconductor lasers and light emitting diodes, optical detectors and receivers, optical amplifiers, system design and performance, passive optical component.

Pedagogical methods and type of evaluation:
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. Final examination is in written form. Some intermediate tests conduct through the semester.

Literature:
1. Govind Agrawal, Fiber optic communication systems, 4th edition, Weley Interscience Publication, 2011.
2. Warren Hioki, Telecommunications, second edition, Prentice Hall, New Jersey, 1995.

Quantum Mechanics

ECTS credits: 7.5
Workload per week: 2 + 3 + 0
Evaluation Method: Written examination
Statute of the Subject: Compulsory course
Semester: VI

Methodological guidance:
Department of Physics
Faculty of Natural Sciences and Mathematics

Lecturer:
Assoc. Prof. Ralitsa Stanoeva, PhD, e-mail: rstanoeva@swu.bg

Annotation:
The course aims at giving fundamentals knowledge of quantum physics and to serve as a foundation for courses as statistical physics, quantum electronics astrophysics and other special courses.

Course content:
Basic quantum mechanical postulates. Quantum mechanical formalism: state space and Hermitean operators. Schrodinger equation: exactly solvable models: Hydrogen atom, harmonic oscilator, potential well.Approximate methods: perturbation theory, Hartry-Fock method. Identical particles and Pauli principle. Angular momentum and spin. Many-electron atoms and periodic system of elements. Scattering theory and Rutherford formula. Klein-Gordon and Dirac equations.

Pedagogical Methods and type of evaluation:
Lectures and seminar classes. Basic knowledge in General Physics and Mathematical methods are needed.
The course is completed by a written examination. Some intermediate tests are conducted through the semester.

Astronomy and Astrophysics

ECTS credits: 5,5
Form of assessment: Written exam
Semester: VI

Weekly workload: 3 + 1 + 0
Statute of the discipline: Compulsory

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

Lecturer:
Chief Assistant Professor Gergana Kalpachka, PhD
e-mail: kalpachka@swu.bg

Annotation:

The discipline „Astronomy and Astrophysics“ is included as compulsory discipline in the specialty curriculum „Physics“. It is studied from students studying at educational and qualification degree „Bachelor“.

The discipline „Astronomy and Astrophysics“ is with total workload 60 hours, which includes 45 hours lectures and 15 hours seminars. The students’ self-study is 105 hours.

Teaching on the discipline „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 discipline 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 discipline „Astronomy and Astrophysics“ ends with a written exam on the educational content. 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 (70 %) and from the current control (30 %).

References:

1. **Carroll, B., D. Ostlie.** An Introduction to Modern Astrophysics. MA, Pearson Addison-Wesley, 2007.

2. **Choudhuri, A.** Astrophysics for Physicists. Cambridge University Press, 2010.

3. Encyclopedia of Astronomy and Astrophysics. Vol. 1–4. Editor in Chief: Paul Murdin. Institure of Physics Publishing, 2001.

4. **Karttunen, H., P. Kröger, H. Oja, M. Poutanen, K. Donner (Eds.).** Fundamental Astronomy. Springer, 2007.

5. **Kitchin, C.** Astrophysical Techniques. Bristol and Philadelphia, IOP Publishing Ltd., 2003.

Energy Efficiency & Energy Management

ECTS credits: 3.0
Workload per week: 2 + 0 + 0
Evaluation Method: Written examination
Statute of the Subject: Compulsory course
Semester: VI

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Maths

Lecturer:
Prof. Dr. Plamen Svetoslavov Gramatikov, M.Eng., Ph.D,
Phone: +359 887 946 199; E-mail: psgramat@swu.bg

Annotation:
The subject is a compulsory course studied by students to acquire a Bachelor degree on Physics. Students acquire basic knowledge about methods and decisions of effective use and management of energy and energy audits in industry. 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. Material is selected depending of the specificity of the speciality.

Course content:
Energy and sustainable development. Energy Efficiency business. Basic principles of Energy Management. Energy Audit. Energy management in industry. CHP technologies. Energy efficiency and environmental protection.

Pedagogical Methods and type of evaluation:
Basic knowledge on General Physics, Mathematics and Thermal Physics are needed. Lectures are visualised by demonstrations and laboratory tasks performance during the laboratory classes. From the Methods point of view material is arranged from Thermal motors and machines via Building Physics to the Energy efficiency and environmental protection. Practical classes are not included.
The course is completed by a written examination. Some intermediate tests are conducted through the semester.

References:
1. Guide to Energy Efficiency and Energy Management (ed. Pl. Gramatikov); OP "Competitiveness" program "Energy Efficiency and Green Economy" (BEECIFF), MEET, 2012. (in Bulgarian).
2. Kaloianov N., D. Baev, D. Doukov. Energy management in small and medium enterprises, a practical guide. http://www.ems-textile.eu/files/Energy_Management_Manual_BG.pdf (in Bulgarian).
3. Turner W. C. Energy Management Handbook, Fairmont Press Inc., 2001.
4. Stum K., R. Mosier, T. Haasl, W. Pletz. Energy Management Systems, A Practical Guide, USA-EPA, 1997.

Laser Technique

ECTS credits: 6.0
Evaluation Method: Written examination
Semester: VII

Type of presentation: 2 + 0 + 2
Status of the Subject: Compulsory

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Mathematics

Lecturer:
Assoc. Prof. Luben Mihov Ivanov, Ph.D.
тел.: 0882 988 712, e-mail: mihovli@swu.bg

Annotation:
The course on laser technology presents the basic physical ideas of quantum electronics and gives a description of the principle of action of the most common laser sources. Physical principles of amplification and light generation based on induced radiation are also considered. Also, the open laser resonators, the principles of action of gas and solid-state lasers, and some convertible laser sources are also considered.

Subject Description:
The course can be divided into two parts. The first part deals with the general principles of laser technology. They are valid for all laser systems. This section discusses induced and spontaneous transitions, Einstein's coefficients, coherence of induced radiation, width and shape of spectral lines, absorption and enhancement of active laser environments, saturation of amplification, generation of laser radiation, open resonators, resistivity of laser resonators , Q-modulation and fashion synchronization. The second part describes the principle of operation of the main laser sources. The most popular gas and solid-state lasers are considered. The laser lasers describe the principle of action of the helium-neon laser, the nitrogen laser, the argon laser and the carbon dioxide laser. The solid state lasers include the ruby laser, the neodymium laser as well as the semiconductor lasers.

Pedagogical methods and type of evaluation: 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. Final examination is in written form. Some intermediate tests conduct through the semester.

Literature:
1. Н.В.Карлов, „Лекции по квантовой електроники”, Москва, Наука, 1980.
2. М. Ненчев, С. Салтиел. „Лазерна техника“, УИ „Св. Климент Охридски“ 1994.
3. Peter W. Milonni, Joseph H. Eberly, „Laser Physics“, Wiley, 2010, ISBN 978-0-470-38771-9.
4. Orasio Svelto, “Principles of Lasers” Fifth edition, Springer, 2010, ISBN 978-1-4419-1301-2.

Thermal Physics

ECTS credits: 6.0
Workload per week: 3 + 1 + 0
Evaluation Method: Written examination
Statute of the Subject: Elective course
Semester: VII

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Maths

Lecturer:
Prof. Dr. Plamen Svetoslavov Gramatikov, M.Eng., Ph.D,
Phone: +359 887 946 199; E-mail: psgramat@swu.bg

Annotation:
The subject is an elective course studied by students to acquire a Bachelor degree on Physics. The students acquire basic knowledges about methods of reception, transformation, transfer and use of heat, as well as with principles of action of the heat and of the thermal installations. For that reason some specific topics are presented which are not included in the Physics programme for non-physical students.

Course content:
Elements of Technical Thermodynamics. Thermodynamic Processes with Ideal and real Gases. Principles of Thermodynamics. Entropy. Basic concepts of Thermal-Mass-Transfer. Conduction, convection, radiation. Complex thermal transfer. Applied Thermotechnics.

Pedagogical Methods and type of evaluation:
Basic knowledge in General Physics, Mathematics and Thermal Physics are needed. Lectures are visualised by demonstrations and laboratory tasks performance during the laboratory classes. The students acquire basic knowledge about methods of reception, transformation, transfer and use of heat, as well as with principles of action of the heat and of the thermal installations.
The course is completed by a written examination. Some intermediate tests are conducted through the semester.

References (all in Bulgarian)**:**
1. Gramatikov P. Lectures on Thermal Physics; N. Rilski Univ., Blagoevgrad, 2012.
2. Dimitrov A. Modern heating technology and energetics; Sofia, 2011.
3. Velev D.S. Technical Thermodynamics and Heat Exchange, A. Kanchev University of Technology, Rousse, 1981.

Preparing the Physical Experiment and Processing of Experimental Data

ECTS credits: 6
Workload per week: 2 + 0 + 2
Evaluation Method: Written examination
Statute of the Subject: Elective course
Semester: VII

Methodological guidance:
Department of Physics
Faculty of Natural Sciences and Mathematics

Lecturer:
Assoc. Prof. Ralitsa Stanoeva, PhD, e-mail: rstanoeva@swu.bg

Annotation:
The course aims to equip students with knowledge about the basic methods for the processing of data in order for them to be able to use them in the analysis of specific experiments.

Course content:
The program contains material about the current state of experimental physics, which in turn requires the use of methods of analysis of measurement results. Practical classes consist in the development of programs, realizing basic procedures for data analysis. Examples are concerned with data from specific experiments, but the methods have a much broader scope. The last exercise is practiced shaping of already processed data in the publication.

Pedagogical Methods and type of evaluation:
Lectures, laboratory classes and individual student's work. Basic knowledge in mathematical methods of physics and analysis are needed.
Evaluation defined by a written exam and current control of the laboratory exercises taken certain gravity. Some intermediate tests are conducted through the semester.

Measurement of Physical Quantities

ECTS credits: 6,0
Weekly workload: 2 + 0 + 2
Form of assessment: Written exam
Statute of the discipline: Elective
Semester: VII

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

Lecturer:
Chief Assistant Professor Gergana Kalpachka, PhD
e-mail: kalpachka@swu.bg

Annotation:

The discipline „Measurement of Physical Quantities“ is included as elective discipline in the specialty curriculum „Physics“. It is studied from students studying at educational and qualification degree „Bachelor“.

The discipline „Measurement of Physical Quantities“ 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 discipline ends with a written exam.

Course content:

1. Role, place and importance of the measurements in physics..
2. International system of units SI.
3. Precision and Errors.
4. Presentation of the results from measurement of physical quantities.
5. Electromechanical devices for measurement of physical quantities.
6. Electronic analog devices for measurement of physical quantities.
7. Electronic digital devices for measurement of physical quantities.
8. Computerized systems for measurement of physical quantities.
9. Methods and tools for measurement electrical physical quantities.
10. Methods and tools for measurement non-electrical physical quantities.

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 laboratory „Measurement of Physical Quantities“. The laboratory exercises are conducted in groups. Students work in subgroups of 2–3 persons at workplace and they perform the practical tasks, which are described in the methodological guidelines and discussed in advance with the assistant. After each conducted laboratory exercise students prepare protocol. The laboratory exercise is considered done after submission and defense of the relevant protocol. Certification of the semester get students who have done all laboratory exercises, who have submitted and defended the relevant protocols and who have received an evaluation of the current control at least „Satisfied 3“ (D).

Teaching on the discipline „Measurement of Physical Quantities“ ends with a written exam on the educational content. 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 (60 %) and from the current control (40 %).

References:

1. **Кирий, А., А. Асенов.** Измерване на топлинни, хидравлични и механични величини. С., ТУ, 2006.
2. **Радев, Х.** Метрология и измервателна техника. Т. 1, 2. С., Софттрейд, 2008, 2010.
3. **Радев, Х.** Метрология и измервателна техника. Т. 3. С., Софттрейд, 2012.
4. **Русев, Д., Б. Матраков, В. Туренков.** Електрически измервания. С:, Техника, 2000.
5. **Стоянов, И., Б. Николова, Г. Николов.** Компютърно-базирани измервателни системи. С., ТУ, 1997.
6. **Трендафилов, Г.** Основи на електроизмервателната техника. Габрово, УИ „Васил Априлов“, 2000.

Modern Methods for Examination of the Aerospace and Natural Environment

ECTS credits: 6,0
Weekly workload: 3 + 1 + 0
Form of assessment: Written exam
Statute of the discipline: Elective
Semester: VII

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

Lecturer:
Chief Assistant Professor Gergana Kalpachka, PhD
e-mail: kalpachka@swu.bg

Annotation:

The discipline „Modern methods for examination of the aerospace and natural environment“ is included as elective discipline in the specialty curriculum „Physics“. It is studied from students studying at educational and qualification degree „Bachelor“.

The discipline „Modern methods for examination of the aerospace and natural environment“ is with total workload 60 hours, which includes 45 hours lectures and 15 hours seminars. The students' self-study is 120 hours.

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

Course content:

1. Sun. Solar System. Planet Earth. Basic methods of their examination.
2. Lithosphere. Magnetosphere. Atmosphere. Hydrosphere. Biosphere. Main characteristics. Methods for examining.
3. Cosmic rays background and magnetosphere. Correlations and methods of their examination.
4. Aerospace environment. Basic parameters of the aerospace environment.
5. Basic methods and instrumentation for study of the aerospace environment. Telescopes, satellite detectors and others.
6. Meteorological parameters. Basic methods for their measurement.
7. Aerosols. Physical characteristics. Atmospheric transport. Basic methods for their measurement.
8. Atmospheric transport of heavy and toxic metals.
9. Atmospheric transport of chemical contaminants. Basic methods for their measurement.
10. Ozone, radon, CO_2 and their role in the atmosphere.
11. Cosmic rays background and meteorological effects.
12. Cosmic rays background, atmosphere and biosphere.
13. Natural environment. Basic parameters and characteristics. Approaches in the study of the natural environment. Control and management of the natural environment.
14. Radioecology and natural environment. Migration of radionuclides. Engineered barriers. Management.
15. Information systems and natural environment. Transmission and analysis of data for the natural environment.

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 discipline ends with a written exam on the educational content. 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 (70 %) and from the current control (30 %).

References:

1. **Ahrens, C., R. Henson.** Essentials of Meteorology: An Invitation to the Atmosphere. Boston, Cengage Learning, 2016.

2. **Dorman, L.** Cosmic Rays in the Earth's Atmosphere and Underground. The Netherlands, Kluwer Academic Publishers, 2004.

3. **Moldwin, M.** An Introduction to Space Weather. USA, Cambridge University Press, 2014.

Acoustics

ECTS credits: 6,0
Form of assessment: Written exam
Semester: VII

Weekly workload: 3 + 0 + 1
Statute of the discipline: Elective

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

Lecturer:
Chief Assistant Professor Gergana Kalpachka, PhD
e-mail: kalpachka@swu.bg

Annotation:

The discipline „Acoustics“ is included as elective discipline in the specialty curriculum „Physics“. It is studied from students studying at educational and qualification degree „Bachelor“.

The discipline „Acoustics“ is with total workload 60 hours, which includes 45 hours lectures and 15 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 discipline ends with a written exam.

Course content:

1. Acoustics as a science. Historical review. Parts of acoustics.
2. Physical nature of the sound.
3. Physiological acoustics.
4. Sound emission and sound sources.
5. Accepting of sound and sound receivers.
6. Spreading of the sound.
7. Doppler effect. Binaural effect.
8. Electroacoustic transducers. Microphones. Loudspeakers. Species. Parameters.
9. Sound systems. Species. Requirements for sound systems.
10. Analog-to-digital and digital-to-analog conversion of audio signals.
11. Acoustics of the premises. Acoustic design. Reverberation time.
12. Protection of buildings from internal and external noise. Acoustic materials. Types and functions.

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 laboratory „Acoustics“. The laboratory exercises are conducted in groups. Students work in subgroups of 2–3 persons at workplace and they perform the practical tasks, which are described in the methodological guidelines and discussed in advance with the assistant. After each conducted laboratory exercise students prepare protocol. The laboratory exercise is considered done after submission and defense of the relevant protocol. Certification of the semester get students who have done all laboratory exercises, who have submitted and defended the relevant protocols and who have received an evaluation of the current control at least „Satisfied 3“ (D).

Teaching on the discipline „Acoustics“ ends with a written exam on the educational content. 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 (60 %) and from the current control (40 %).

References:

1. **Berg, R., D. Stork.** The Physics of Sound (3rd Edition). Pearson, 2004, pp. 398.
2. **Kinsler, L., A. Frey, A. Coppens, J. Sanders.** Fundamentals of Acoustics. USA, John Wiley & Sons, Inc., 2000, pp. 560.
3. Acoustics
https://en.wikibooks.org/wiki/Acoustics

Physical Methods in Medicine

ECTS credits: 6.0
Evaluation Method: Written examination
Semester: VII

Type of presentation: 2 + 0 + 2
Status of the Subject: Eligible

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Mathematics

Lecturer:
Assoc. Prof. Luben Mihov Ivanov, Ph.D.
тел.: 0882 988 712, e-mail: mihovli@swu.bg

Annotation:
The course introduces students to the fundamentals of optical polarimetry and practical use of optical methods and technologies in biology and medicine. The course discusses the principles and applications of basic optical diagnostic and therapeutic techniques and presents the biophysical basis of the therapeutic effect of optical interactions and their effects at the cellular, tissue, organ and system level on living organisms.

Subject Description:
The course aims to equip students with lasting knowledge of the fundamental principles upon which operate modern medical devices based on optical systems, their capabilities for diagnosis and treatment. The course demonstrates the direct practical application of the laws of optics in medicine and biology and shows the relationship between theory and practice.

Pedagogical methods and type of evaluation:
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. Final examination is in written form. Some intermediate tests conduct through the semester

Literature:
1. R.D. Guenther, Modern Optics, John Wiley & Sons, ISBN 0-471-60538-7, 1990.
2. M.A., Azzam and N.M., Bashara, Ellipsometry and polarized light, North Holland Publishing Company, 1977.
3. H. Fujiwara, Spectroscopic Ellipsometry – Principles and Applications, WILEY, 2007.
4. M. Born, E. Volf, Principles of Optics, Pergamon Press, 1965.
5. J-C. del Toro Iniesta, Introduction to Spectropolarimetry, Cambridge Univesity Press, 2004.
6. D. Pye, Polarised Light in Science and Nature, IOP Publishing Ltd., 2001.
7. Handbook of Ellipsometry, ed. By H. Tompkins and E. Irene, William Andrew Publishing and Springer, 2005.

Interaction of Radiation with Matter

ECTS credits: 6.0
Evaluation Method: Written examination
Semester: VII

Type of presentation: 2 + 0 + 2
Status of the Subject: Eligible

Methodological guidance: Physics Department
Faculty of Natural Sciences & Mathematics

Lecturer:
Prof. Peter Petrov, D Sc
тел.: 359887946199; E-mail: pitiv@ie.bas.bg

Annotation:
The course "Interaction of Radiation with the matter" is a specialized course in the training of the students for acquiring the Bachelor's degree in Physics. The aim of the course is to give the students specialized knowledge on the main problems And solutions for the efficient use of different sources of radiation for a variety of technological applications. The theoretical foundations and the practical application of different technological methods of welding, thermal treatment, surface modification, obtaining of wear resistant and corrosion resistant coatings with laser sources and high energy electron beams are studied. The material has been selected in accordance with the intended workload, and within the reasonable compromise between the theoretical and applied material, priority is given to the applied subject of the topics under consideration. The mathematical apparatus is consistent with the level of preparation of the students at the Bachelor's degree.

Subject Description:
The subject deals with the application of concentrated energy streams of electronic and photon light beams, the basic technological applications of welding lasers, thermal processing, coating deposition, cutting and drilling of holes. The energy balance, the heat flow, the heat transfer equation, models, heat field distribution, thermal cycles are examined. Particular attention is paid to the physical bases of electron and laser welding, structural changes of materials, stresses and defects in welded joints of electron beam and laser thermal treatment, alloying and hybrid metal and alloy processing methods.

Pedagogical methods and type of evaluation:
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. Final examination is in written form. Some intermediate tests conduct through the semester

Literature:
1. N.N. Rykalin, A.A. Uglov, A.G. Zuev, A.N. Kokora, “Laser and electron-beam treatment of materials”, Moscow, Mashinostroene Publishers, (1985) 495 pages (in Russian).
2. V. Michailov, V Karhin, P. Petrov, “Baisic of welding”, Stroitelstvo, 197p, (2012). (in Bulgarian)
3. G. Mladenov “Electron and ion beam technologies”, Marin Drinov, 387 p., (2009). (in Bulgarian)

Spectral Analyse

ECTS credits: 6,0
Hours per week: 3 + 1 + 0
Form of knowledge evaluation: Written Examination
Statute of the subject: Optional
Semester: VII

Methodological guidance:
Department: „Chemistry”
Faculty of Mathematics and Natural Sciences

Lecturer:
Assoc. Prof. Atanas Chapkanov
chapkanov@swu.bg

Short Description:

The students will obtain basic knowledge on some of main instrumental methods for description of various organic compounds and functional groups. Application of the methods for qualitative and quantitative analysis is given for various compounds. The students will be study and considered the main characteristic frequencies and resonance signals of the various compounds and interpretation of the obtained results.

Course Aims:

The aim of the course is to give students knowledge on FAAS, UV-, IR-, Raman, NMR- and ICP-MS spectral method and approaches to identification of various compounds. The lab exercises should give students knowledge and skillfulness to carry out analysis.

Teaching Methods:

Lectures are illustrated with examples for solving problems related to interpretation of various spectra of complicated samples. For lectures presentation multimedia PC system are used.

Requirements:

Knowledge in chemistry, physics, mathematics and et.

Registration for the course:

A request by students at the end of the previous term.

Exam:

Test, current control (lectures and labs), course work and final written exam.

Final evaluation:

FE = 0.4 CC + 0.6 WE

Registration for the exam:

Coordination with lecturer and Students Service Department.

Physical Processes in Nuclear Power Stations

ECTS credits: 5.0
Workload per week: 3 + 1 + 0
Evaluation Method: Written examination
Statute of the Subject: Elective course
Semester: VIII

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Maths

Lecturer:
Prof. Dr. Plamen Svetoslavov Gramatikov, M.Eng., Ph.D,
Phone: +359 887 946 199; E-mail: psgramat@swu.bg

Annotation:
The subject is an elective course studied by students to acquire a Bachelor degree on Physics. Students acquire basic knowledges about basic processes and parameteres of the modern nuclear power stations. Special attention is paid to the PWR-440 and PWR-1000 reactors, working in this country, to the methods of radiation safety and environmental protection.

Course content:
Nuclear reactions by neutrons. Delay and diffusion of neutrons. Physical basics of nuclear reactors. Nuclear reactors' theory. Critical (geometry and material) reactor's parameteres. Migration of neutrons. Kinetics of nuclear reactors. Types of nuclear reactors. Reactors regulation. Reactor's biological radiation protection. Nuclear power stations. Emergency situations and specific requirements to Nuclear power stations.

Pedagogical Methods and type of evaluation:
Basic knowledge in General, Atomic, Nuclear and Thermal Physics are needed. Lectures are visualised by demonstrations and laboratory tasks performance during the laboratory classes. The students acquire basic knowledge about methods of reception, transformation, transfer and use of heat, as well as with principles of action of the heat and of the thermal installations.
The course is completed by a written examination. Some intermediate tests are conducted through the semester.

References:
1. Gramatikov P.S. Nuclear Physics with elements of radiation protection and dosimetry, SWU, Blagoevgrad, 2008.
2. Gluhov GA, Lakov M. Fundamentals of Nuclear Engineering, Ciela, Sofia, 2011.
3. Lakov M., Gluhov G. A. Nuclear Reactors and Steam Generation Installations, Ciela, Sofia, 2011.
4. Nozharova S.A. Atomic Power Plants, Technika, Sofia, 1979.
5. Margulova T. Kh. Nuclear power stations, Higher School, Moscow, 1978.
6. Rudik A.P. Physical Foundations of Nuclear Reactors, Atomizdat, Moscow, 1979.
7. Bell D., Gleston S. Theory of Nuclear Reactors, Atomizdat, Moscow, 1974.

Environmental Physics

ECTS credits: 5
Workload per week: 2 + 0 + 2
Evaluation Method: Written examination
Statute of the Subject: Elective course
Semester: VIII

Methodological guidance:
Department of Physics
Faculty of Natural Sciences and Mathematics

Lecturer:
Assoc. Prof. Ralitsa Stanoeva, PhD, e-mail: rstanoeva@swu.bg

Annotation:
The course includes studying of the basic physical phenomena in the environment, including the Distribution and properties of the water, structure and energy balance of the atmosphere, heat, electromagnetic, noise and aerosol-pollutions.

Course content:
The students in physics have to receive ground knowledge about using the contemporary physical Methods in the monitoring of the environment.

Pedagogical Methods and type of evaluation:
Lectures, laboratory classes, homework and tutorials. Basic knowledge in General Physics (parts mechanics, molecular physics, thermodynamics and electricity) are needed.
The course is completed by a written examination. Some intermediate tests are conducted through the semester.

Electromagnetic Compatibility of the Electronic Systems for Measurement of Physical Quantities

ECTS credits: 5,0
Weekly workload: 3 + 1 + 0
Form of assessment: Written exam
Statute of the discipline: Elective
Semester: VIII

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

Lecturer:
Chief Assistant Professor Gergana Kalpachka, PhD
e-mail: kalpachka@swu.bg

Annotation:

The discipline „Electromagnetic compatibility of the electronic systems for measurement of physical quantities“ is included as elective discipline in the specialty curriculum „Physics“. It is studied from students studying at educational and qualification degree „Bachelor“.

The discipline is with total workload 60 hours, which includes 45 hours lectures and 15 hours seminars. The students' self-study is 90 hours.

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

Teaching on the discipline ends with a written exam.

Course content:

1. Electromagnetic environment. Electromagnetic interference.
2. Unintentional electromagnetic interference. Parameters, sources and models.
3. Parasitic coupling mechanisms. Basic positions. Capacitive and inductive connection.
4. Measurements of the electromagnetic compatibility. Types. Methods and devices.
5. Spectrum analyzers. Analyzers with sequential and with simultaneous transformation.
6. Electrostatic discharge. Models. Electrostatic discharge in different environments. Impact of the electrostatic discharge on the electronic components and circuits.
7. Shielding. Basic positions. Shielding at capacitive and at inductive connection.
8. Grounding. Basic principles and rules. Grounding in the electronic circuit technique.
9. Normative documents. Electromagnetic compatibility directives. Bulgarian state standards.

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 discipline „Electromagnetic compatibility of the electronic systems for measurement of physical quantities“ ends with a written exam on the educational content. 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 (70 %) and from the current control (30 %).

References:

1. **Christopoulos, C.** Principles and techniques of electromagnetic compatibility. CRC Press, 2007.
2. **Duff, W. G.** Designing Electronic Systems for EMC. SciTech Publishing, 2011.
3. **Ott, H.** Electromagnetic compatibility engineering. New Jersey, John Wiley & Sons, 2009.
4. **Paul, C.** Introduction to electromagnetic compatibility. New Jersey, John Wiley & Sons, 2006.
5. **Weston, D.** Electromagnetic compatibility. Principles and applications. Marcel Dekker, 2001.
6. Guide for the EMC Directive 2004/108/EC. 2010.

Computer Methods in Physics

ECTS credits: 5,0
Form of assessment: Written exam
Semester: VIII

Weekly workload: 3 + 1 + 0
Statute of the discipline: Elective

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

Lecturer:
Chief Assistant Professor Gergana Kalpachka, PhD
e-mail: kalpachka@swu.bg

Annotation:

The discipline „Computer methods in physics“ is included as elective discipline in the specialty curriculum „Physics“. It is studied from students studying at educational and qualification degree „Bachelor“.

The discipline „Computer methods in physics“ is with total workload 60 hours, which includes 45 hours lectures and 15 hours seminars. The students’ self-study is 90 hours.

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

Teaching on the discipline ends with a written exam.

Course content:

1. Computer methods for research of physical objects, phenomena and processes. Computer modeling and simulations in physics.
2. Computer methods for receiving, processing and presenting results from physical experiments.
3. Computer methods for analysis and interpretation of experimental data.
4. Computer methods for image analysis and recognition.
5. Computer methods for mathematical calculations in physics.
6. Possibilities and application of MS Excel in physics.
7. Possibilities and application of a software product Origin in physics.
8. Possibilities and application of a software product Maple in physics.
9. Computer methods in different chapters of physics.

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 discipline „Computer methods in physics“ ends with a written exam on the educational content. 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 (70 %) and from the current control (30 %).

References:

1. **Аладьев, В., В. Бойко, Е. Ровба.** Программирование и разработка приложений в Maple. Таллинн, 2014.
2. **Фрай, К.** Microsoft Excel 2016. Step by Step. С., АлексСофт, 2017.
3. **Червенкова, Т., А. Червенков.** Числени методи и моделиране на вериги и полета. С., ТУ, 2007.
4. **Allen, M., D. Tildesley.** Computer Simulation of Liquids. Oxford, Oxford University Press, 2017.
5. **Burden, R., J. Faires.** Numerical Analysis. Boston, Brooks/Cole Publishing Company, 2014.
6. Origin 2017
   http://www.originlab.com/

Biophysics

ECTS credits: 5.0
Workload per week: 3 + 1 + 0
Evaluation Method: exam
Statute of the Subject: Elective course
Semester: VIII

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Maths

Lecturer:
Prof. Dr. Plamen Svetoslavov Gramatikov, M.Eng., Ph.D,
Phone: +359 887 946 199; E-mail: psgramat@swu.bg

Annotation:
The course of Biophysics is based on the preceding mandatory courses on Physics and on other specialised subjects of the curriculum. The program includes basic knowledge about the most important physical phenomena in biological systems at molecular, cellular and organism level. Emphasis is placed on the structure, properties and special role of water for the functioning of biological systems and the structure of the most important bio organic compounds.
The aim is to give to students some basic knowledge about the most important physical phenomena in biological systems and they to be familiar with basic physical problems, specific approaches and methods for studying self-organization of matter.

Course content:
Attention is paid to the thermodynamic study approach of living systems, to the properties of dissipative structures, entropy of living nature, phase transitions of I and II type, fractal structures and dimensions, physics of biopolymers and to the unique and anomalous properties of water, etc.

Pedagogical Methods and type of evaluation:
Lectures illustrated with graphics pre-developed on Power point and Seminars with decision of theoretical and practical tasks. From methodical point of view the material is arranged from the thermodynamic approach at study of alive systems via Biopolymer Physics to the basic models of water structure and its properties.
The workshops are conducted in specialized laboratories. During the seminars students perform practical tasks described in the methodological guidelines and discussed in advance with the assistant.
Two intermediate tests conducted during the semester and written final exam upon the lecture course.

References:
1. Gramatikov P.S. Theoretical Biophysics, SWU, Blagoevgrad, 1998 (in Bulgarian).
2. Florov R.J. Thermodynamics of Biosystems, BAS, Sofia, 1988 (in Bulgarian).
3. Ivanov I.T. Textbook on Medical and Biological Physics, Alpha Market, Zagora, 2008 (in Bulgarian).
4. Marinov M. Biophysics, Sofia, 2003 (in Bulgarian).
5. Laskowsy B., W. Pohlit, Biophysik, Georg Thieme Verlag, Stuttgart, 1974.

Practice in Astronomy

ECTS credits: 5,0
Form of assessment: Current assessment
Semester: VIII

Weekly workload: 0 + 0 + 4
Statute of the discipline: Elective

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

Lecturer:
Chief Assistant Professor Gergana Kalpachka, PhD
e-mail: kalpachka@swu.bg

Annotation:

The discipline „Practice in Astronomy“ is included as elective discipline in the specialty curriculum „Physics“. It is studied from students studying at educational and qualification degree „Bachelor“.

The discipline „Practice in Astronomy“ is with total workload 60 hours laboratory exercises. The students' self-study is 90 hours.

Teaching on the discipline „Practice in Astronomy“ 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:

Conducting laboratory exercises (observations and research) in astronomy at the National Astronomical Observatory „Rozhen“.

Teaching methods and evaluation:

To conduct the laboratory exercises is used the material base of the National Astronomical Observatory „Rozhen“. The laboratory exercises are conducted in groups. Students perform the practical tasks. 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 discipline „Practice in Astronomy“ ends with a current assessment. The current assessment is the evaluation of the current control that is conducted during the laboratory exercises.

References:

1. **Ефремов, Ю.** Вглубь Вселенной. Звезды, галактики и мироздание. Москва, Едиториал УРСС, 2003.

2. **Засов, А., К. Постнов.** Общая астрофизика. Фрязино, Век 2, 2006.

3. **Carroll, B., D. Ostlie.** An Introduction to Modern Astrophysics. MA, Pearson Addison-Wesley, 2007.

4. **Choudhuri, A.** Astrophysics for Physicists. Cambridge University Press, 2010.

5. Encyclopedia of Astronomy and Astrophysics. Vol. 1–4. Editor in Chief: Paul Murdin. Institure of Physics Publishing, 2001.

6. **Karttunen, H., P. Kröger, H. Oja, M. Poutanen, K. Donner (Eds.).** Fundamental Astronomy. Springer, 2007.

7. **Kitchin, C.** Astrophysical Techniques. Bristol and Philadelphia, IOP Publishing Ltd., 2003.

8. Philip's Astronomy encyclopedia. A comprehensive and authoritative A-Z guide to the Universe. Octopus Publishing Group Ltd., 2002.

9. **Romanishin, W.** An Introduction to Astronomical Photometry Using CCDs. University of Oklahoma, 2006.

10. http://www.bgastronomy.com/index.php?cat=15

11. http://astronomy4all.com/index.html

Practicum in Optical Technologies

ECTS credits: 3.0
Type of presentation: 0 + 0 + 2
Evaluation Method: exam
Status of the Subject: Eligible
Semester: VIII

Methodological guidance:
Physics Department
Faculty of Natural Sciences & Mathematics

Annotation:

The optional course "Practicum in Optical Technologies" is a specialized course in the training of students for acquiring the Bachelor's Degree in Physics. The aim of the course is students to acquire knowledge in optical technologies and to develop practical skills and competences for working with optical instruments, for monitoring and investigation of different physical processes, for processing, presentation, analysis and interpretation of experimental results, etc. . The laboratory exercises included in the curriculum are conducted in real conditions at the Physics Institutes of the Bulgarian Academy of Sciences. The expected results in the study of the course "Practicum in Optical Technologies" are the students to learn about various optical instruments and apparatuses and to develop practical skills and competences.

Subject Description:

The content of the Practicum of Optical Technology Practice course is structured to give students a specialized knowledge of the basic optical devices used in the field of research and other varied technological applications. The course involves introduction in the principles of working of the laser and the main laser sources. The main practical exercises are: familiarization with the features of gas lasers (Cu laser, Ar laser, He-Ne laser); familiarization with the device of solid state lasers (Rb laser, Nd: YAG laser); monitoring of the Q-modulation and laser mode synchronization; laser processing of materials. laser cutting, laser welding, laser ablation; use of lasers to create nanostructures; introduction to optical methods for research and diagnostics in medicine and biology; lidar systems for atmospherics observation.

Pedagogical methods and type of evaluation:

Organization of the training is carried out according to the curriculum in force. During each laboratory exercise students prepare the relevant protocols. The discipline ends with an assessment of current control, which is an evaluation of the prepared and protected protocols.

Literature:

1. Justin Pedtrose, Mihael Ware, „Physics of Light and Optics" Brigham Young University,
2. Трофимова, Курс физики", Университетско издателство Св. Кл. Охридски", София, 1994.
3. Н. Н. Рикалин, А. А. Углов, А. Г. Зуев, А. Н. Кокора, "Лазерная и электроннолучевая обработка материалов", Москва, Машиностроене, (1985) 495 с.

Language Culture

ECTS: 2
Form of assessment: exam
Semester: VIII

Weekly classes: L-0; S-0; E-2, IL-2
Course type: Select

Course coordinating department:
Department of Bulgarian language
Philological Faculty

Lecturer:
Prof. Antoni Stoilov, PhD
E-mail: antony100@swu.bg
Тел. 0894 426 026

Annotation

Students learn spelling and pronouncing rules in modern Bulgarian.

Course content

Rules for writing titles and subtitles. Rules for writing capital letters. Rules for merged, semi-merged and separate writing of nouns, adjectives, numerals, adverbs and complex prepositions . Rules for writing a comma. Rules for writing variable **Я**. Rules for writing articles. Syntactic agreement. Rules of the utterance verb endings of the definite articles and prepositions.

Teaching and grading methods

Practical classes.

Written exam. Students need to eliminate spelling and punctuation errors in a text. Grading is done according to a specific scale.