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INFORMATION PACKAGE

/ECTS/

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

PROFESSIONAL FIELD: **4.1. PHYSICS SCIENCES**

SPECIALTY: **METROLOGY**

Educational and qualification degree: **Bachelor of Science**

Professional qualification: **Physicist – Specialist of Metrology**

Period of study: **4 years (8 semesters)**

Form of training: **Regular**

ANNOTATION

The bachelor program of „Metrology“ has duration of 4 years and is designed to prepare professionals of Professional Division „Natural sciences“ with qualification name "physicist-specialist of metrology" who knows how to apply physics in research and a wide range of applications activities. Students who have completed the degree "Bachelor" receive theoretical and applied knowledge of basic physical and mathematical disciplines, which enables them to good career, also continue their education in the educational qualifications "Master's Degree". The curriculum of the degree "Bachelor" is designed in accordance with the requirements for specialty agreed with European standards for the level of training. The curriculum contains courses, divided into three categories - mandatory, optional and elective courses that give students the opportunity by electivity courses to receive theoretical and applied knowledge of modern physics departments and their application in other sciences and manufacturing.

Specialists who graduate from the program „Metrology“ are able to work in laboratories and quality control centers, to become employees in the State Agency for Metrological and Technical Surveillance or in scientific institutes and laboratories in professional division Physics and related sciences.

CURRICULUM

Field of Study: „Physics“, Period of Study: 4 years (8 semesters)

First Year			
First semester	**ETCS credits**	**Second semester**	**ETCS 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 Technique and Technologies	6.0
Mechanics	12.5	Molecular Physics and Thermodynamics	12.5
Foreign language – part 1	2.0	Foreign language – part 2	2.0
Sport	1.5	Sport	1.5
	Total 30		Total 30
Second Year			
First semester	**ETCS credits**	**Second semester**	**ETCS 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 Thermothechics	7.0	Theoretical mechanics	7.0
Sport	1.5	Discrete optimization	3.0
		Sport	1.5
	Total 30		Total 30
Third year			
First semester	**ETCS credits**	**Second semester**	**ETCS credits**
Compulsory Courses		Compulsory Courses	
Atomics Physics	9.0	Nuclear Physics	8.5
Condensed Matter Physics	6.0	Optoelectronics and optical communications	5.5
Electrodynamics	8.0	Quantum mechanics	7.5
Radiophysics	3.5	Astronomy and Astrophysics	5.5
General metrology	3.5	Energy efficiency and energy management	3.0
	Total 30		Total 30
Fourth Year			
First semester		**Second semester**	
Compulsory Courses		Software of measuring instruments	5.0
Laser Technique	6.0	Optional I	5.0
Measurement of Physical Quantities	6.0	Optional I	5.0
Optional I	6.0	Optional I	5.0
Optional I	6.0		
Optional I	6.0	Graduation project	10.0
	Total 30		Total 30

DESCRIPTIONS OF THE COURSES

LINEAR ALGEBRA AND ANALYTIC GEOMETRY

Semester: 1 semester
Course Type: lectures and tutorials
Hours per Week/FS/SS: 2 lecture hours and 2 tutorial hours per week/FS
ECTS Credits: 7 credits
Lecturer: Prof. Ilya Gyudzhenov, PhD
Department: Mathematics
Course Status: Compulsory Course

Course Description: The main purpose of the course is to ensure a functional training of the students in computer science for studying other mathematical courses and for applying their theoretical knowledge for solving particular problems in computer science. Basic topics from both Linear Algebra and Analytic Geometry are included.

Course Aims: Students should obtain theoretical basis necessary for the successful study of other courses and for applying the acquired knowledge for solving particular problems in computer science.

Teaching Methods: lectures, tutorials, consultations, homework, course projects, midterm exams

Requirements/Prerequisites: High school knowledge on operations with real numbers

Assessment: Students with average grade of midterm exams equal to Very good 4,50 or higher, do not sit for a written exam on problem solving. The first part of the final exam consists in problem solving: 2 or 3 problems (for students with midterm average grade below Very good 4,50); students with grade of Satisfactory 3,00 or higher sit for the second part of the final exam which consists in writing on two theoretical topics from the syllabus: one in Linear Algebra and one in Analytic Geometry. The final grade is formed by the midterm exams and the final exam in the ratio of 30 %: 70 %. During the semester and before the final exam, students can ask for individual or group consultation given by the lecturer or the tutor during the week time for consultations, or after the negotiation with the lecturer.

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

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

References:
Basic Titles:
1. Борисов А., И.Гюдженов, Линейна алгебра и аналитична геометрия. Благоевград, 1999 г.
2. Борисов А., И.Гюдженов, Илинка Димитрова. Линейна алгебра, Благоевград, 2009 г.
3. Борисов А., И.Гюдженов. Математика 1-ва част, Благоевград, 2010 г.
4. Борисов А., М. Кацарска. Ръководство за решаване на задачи по линейна алгебра и аналитична геометрия. Благоевград, 2011 г.
5. Борисов А., Ръководство за решаване на задачи по аналитична геометрия. Благоевград, 2011 г. ДОПЪЛНИТЕЛНА 1. Курош, А.Г., Курс по висша алгебра "Наука и изкуство", София, 1968 2. Обрешков, Н., Висша алгебра, "Наука и изкуство" , 1962

MATHEMATICAL ANALYSIS - I PART

Semester: 1 semester
Type of the course: Lectures and tutorial
Hours per week /FS /SS: 2 lecture hours and 2 tutorial hour /SS/
ECTS credits: 7 credits
Lecturers: Assoc. Prof. D-r. Vassil Grozdanov
Department: Department of Mathematics, FNSM, SWU "Neophit Rilsky"
Course Status: Compulsory course

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:
1.V. A. Ilin, V. A. Sadovnichi, B. H. Sendov, Mathematical Analysis, V. 1 and 2, Sofia, Science and Art, 1989.
2.Ia. Tagamlitzky, Differential Calculation, Sofia, Science and Art, 1971.
3.Ia. Tagamlitzky, Integral Calculation, Sofia, Science and Art, 1971.

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

Lecturers:
Assoc. Prof. Radost Vassileva,

тел.: 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 trainingandassessment:
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:

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

FOREIGN LANGUAGE 1

Semester: Second semester
Course type: Seminars
Hours per week: 2 hours per week / Summer Semester
ECTS credits: 2
Lecturer: Assist. Prof. Bilyana Georgieva
Course Status: Compulsory course

Course description: Introducing students to the basic components of English phonology, morphology and syntax. It helps students learn and practice communicating in everyday situations including asking and answering questions, using the telephone, taking messages, initiating conversations, asking for directions, making invitations and closing conversations. Class activities include role-playing, small-group activities and short presentations. It also develops skills in reading speed and comprehension. Students are introduced to reading strategies such as skimming, scanning, guessing meaning from context, previewing, predicting, making inferences and giving opinions. Reading materials include short stories, news articles, computer passages and a simplified novel.

Goal: The goals of the course is to enable students to speak and write effectively and confidently in their professional and personal lives. Students become acquainted with the basic terminology in the specific field.

Teaching methods: Seminars

Prerequisites: The knowledge acquired at high school is useful.

Examination and assessment procedures: The estimation of the acquired knowledge is based on a written exam

Registration for examination: coordinated with the lecturer and the academic affairs department

MATHEMATICAL ANALYSIS II

Semester: second semester
Course Type: lectures and seminars
Hours per Week/SS: 2 lecture hours and 2 seminars hour per week
ECTS Credits: 8 credits
Lecturers: Associete Professor Visil Grozdanov, Ph.D.
Department: Mathematics
Course Status: Compulsory course

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).

FUNDAMENTALS OF THE COMPUTER TECHNIQUE AND TECHNOLOGIES

Semester: II
ECTS credits: 6.0
Weekly workload: 0 + 0 + 3
Form of assessment: Current assessment
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 „Fundamentals of the Computer Technique and Technologies“ is included as compulsory discipline in the specialty curriculum „Metrology“. 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.

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 trainingandassessment:
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 2

Semester: 3 semester
Course type: Seminars
Hours per week: 2 hours per week / Fall Semester
ECTS credits: 2.0
Lecturer: Assist. Prof. Bilyana Georgieva
Course Status: Compulsory course

Course description: Introducing students to the basic components of English phonology, morphology and syntax. It helps students learn and practice communicating in everyday situations including asking and answering questions, using the telephone, taking messages, initiating conversations, asking for directions, making invitations and closing conversations. Class activities include role-playing, small-group activities and short presentations. It also develops skills in reading speed and comprehension. Students are introduced to reading strategies such as skimming, scanning, guessing meaning from context, previewing, predicting, making inferences and giving opinions. Reading materials include short stories, news articles, computer passages and a simplified novel.

Goal: The goals of the course is to enable students to speak and write effectively and confidently in their professional and personal lives. Students become acquainted with the basic terminology in the specific field.

Teaching methods: Seminars

Prerequisites: The knowledge acquired at high school is useful.

Examination and assessment procedures: The estimation of the acquired knowledge is based on a written exam

Registration for examination: coordinated with the lecturer and the academic affairs department

ELECTRICITY AND MAGNETISM

Semester 3
ECTS credits: 11.5
Lecturer: Assoc. Prof. Luben Mihov Ivanov, Ph.D.
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66, Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Physics
Status of the Subject: Compulsory

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.

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

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

Preliminary Requirements: Basic knowledge in Physics and Mathematics.

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

Evaluation Method: Final examination in written form. Some intermediate tests conduct through the semester.

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

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

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

Semester: III
ECTS credits: 7.0
Lecturer: Prof. Plamen Svetoslavov Gramatikov, M.Eng., Ph.D.
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66, Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Physics
Status of the Subject: Compulsory course.

Subject Description: 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.

Specific Goals of the Subject: 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.

Pedagogical Methods: Lectures and Seminars on the Thermophysics. From the Methods point of view material is arranged from Thermal motors and machines via Building Physics to the Energy efficiency and environmental protection.

Preliminary Requirements: Basic knowledge on General Physics, Mathematics and Thermal Physics.

Subsidiary Materials: Educational literature on Thermotechnics and printed materials on the topics given by lecturer.

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

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

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

OPTICS

Semester: IV
Lecturer: Assoc. Prof. Luben Mihov Ivanov Ph.D.
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66, Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Physics
Status of the Subject: Compulsory

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

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

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

Preliminary Requirements: Basic knowledge in Physics and Mathematics.

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

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

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

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

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 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. 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

Semester: 4 semester
Cours Tipe: Lectures and seminar exercises
Hours per week/FS/SS: 2 lecture hours, 3 seminar exercises hours per week/FS
ECTS credits: 7 credits
Lecturer: Assoc. Prof. Ralitsa Stanoeva, PhD
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66 Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Physics
Status of the Subject: Compulsory

Subject Description: 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.

Specific Goals of the Subject: 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.

Pedagogical Methods: 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.

Preliminary Requirements: Basic knowledge in General Physics (Mechanics) and Mathematical Calculus.

Subsidiary Materials: Educational literature on Classical Mechanics.

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

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer and the Students Service Department

Note: The lecture course could be suitable for students of other natural sciences

DISCRETE OPTIMIZATION

Semester: 4 semester
Cours Tipe: Lectures and tutorials
Hours per week/FS/SS: 2 lecture hours, 1 tutorial hour per week/SS
ECTS credits: 3 credits

Lecturer: Prof. Ivan Asenov Mirchev, DrSc

Department: Department of Computer Science, e-mail: mirchev@swu.bg

Course Status: Obligatory course in the Physics B.S. Curriculum.

Short Description:

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

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

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

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

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

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

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

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

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

The chinest postman and related arc routing problems (Euler tours and Hamiltonian

tours, the postman problem for undirected graphs, the postman problem for directed graphs).

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

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

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

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

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

Requirements/Prerequisites: Linear Algebra, Linear optimization

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

Rating: = 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)

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

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

References:

1. Mirchev,Iv., "Graphs". "Optimization algorithms for networks", Blagoevgrad, 2001 (in Bulgarian).
2. Mirchev,Iv., "Mathematical programming", Blagoevgrad, 2000 (in Bulgarian).
3. Minieka, E., "Optimization Algorithms for Networks and Graphs, Marcel dekker, Inc., New York and basel, 1978 /Майника, Э.Алгоритмы оптимизации на сетях и графах, М., "Мир" р1981/.

Additional:

1. Keijo Ruohonen. GRAPH THEORY. math.tut.fi/~ruohonen/GT_English.pdf, 2008
2. A book on algorithmic graph theory, http://code.google.com/p/graph-theoryalgorithmsbook/;
3. Ronald Gould. Graph Theory (Dover Books on Mathematics. 2012. US Cafifornia.
4. Lih-Hsing Hsu , Cheng-Kuan Lin, Graph Theory and Interconnection Networks. 1420044818, 2008,
5. Team DDU.Christofides, N., Graph Theory. An Algorithmic approach, Academic Press lnc (London) Ltd. 1975, 1977 (Крисгофидес, И. Теория графов. Алгоритмический подход, М., "Мир", 1978).
6. Swamy, M., К. Thulasirman, Graphs, Networks and Algorithms, John Wiley & Sons, 1981 (Сваами М., К. Тхуласирман. Графм, сети и алгоритми, М., "Мир", 1984).

Abbreviation: SS: Spring Semester

ATOMIC PHYSICS

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

Semester: V
ECTS credits: 6.0
Weekly workload: 3 + 0 + 1
Form of assessment: Written exam
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 „Condensed Matter Physics“ is included as compulsory discipline in the specialty curriculum „Metrology“. 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

Semester: 5 semester
Cours Tipe: Lectures and seminar exercises
Hours per week/FS/SS: 2 lecture hours, 3 seminar exercises hours per week/FS
ECTS credits: 8 credits
Lecturer: Assoc. Prof. Ralitsa Stanoeva, PhD
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66 Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Physics
Status of the Subject: Compulsory

Subject Description: 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.

Specific Goals of the Subject: 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.

Pedagogical Methods: 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.

Preliminary Requirements: Basic knowledge in General Physics and Mathematical methods.

Subsidiary Materials: Educational literature on Classical Electrodynamics and Special Relativity.

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

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer and the Students Service Department

Note: The lecture course could be suitable for students of other natural sciences

RADIOPHYSICS

Semester: V
Lecturer: Assoc. Prof. Luben Mihov Ivanov, Ph.D.
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66, Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Physics
Status of the Subject: Compulsory

Subject Description: 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.

Specific Goals of the Subject: The course aims to familiarize students with the basic laws describing AC circuits and electromagnetic and waves.

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

Preliminary Requirements: Basic knowledge in Physics and Mathematics.

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

Evaluation Method: Final examination in written form. Some intermediate tests conduct through the semester.

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

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

GENERAL METROLOGY

Semester: V
Workload per week: 3 + 0 + 1
ECTS credits: 3.5
Evaluation Method: Written examination
Statute of the Subject: Compulsory course
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 Metrology. 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

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

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

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

OPTOELECTRONICS AND OPTICAL COMMUNICATIONS

Semester: VI
Lecturer: Assoc. Prof. Luben Mihov Ivanov Ph.D.
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66, Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Physics

Status of the Subject: Compulsory

Subject Description: The course considers physical principles optical communication system. The basic topics are 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, optical sources and transmitters including semiconductor lasers and light emitting diodes, optical detectors and receivers, optical amplifiers and system design and performance, passive optical system components.

Specific Goals of the Subject: Students acquire knowledge about general principles of light wave communication system as most attractive communication system in last years.

Pedagogical Methods: Lectures are visualized by demonstrations. During the seminar classes students solve varied problems on optics.

Preliminary Requirements: Basic knowledge in Optics and Mathematics.

Subsidiary Materials: Educational literature on Optical communications system and printed materials on the topics given by lecturer.

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

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

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

QUANTUM MECHANICS

Semester: 6 semester
Cours Tipe: Lectures and tutorials
Hours per week/FS/SS: 2 lecture hours, 3 tutorial hours per week/SS
ECTS credits: 7.5 credits
Lecturer: Assoc. Prof. Ralitsa Stanoeva, PhD
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66 Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Physics
Status of the Subject: Compulsory

Subject Description: 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.

Specific Goals of the Subject: 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.

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

Requirements/Prerequisites: General knowledge in mathematical methods of physics and analysis

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

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

ASTRONOMY AND ASTROPHYSICS

Semester: VI
ECTS credits: 5.5
Weekly workload: 3 + 1 + 0
Form of assessment: Written exam
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 „Metrology“. 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

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

- Guide to Energy Efficiency and Energy Management (ed. Pl. Gramatikov); OP "Competitiveness" program "Energy Efficiency and Green Economy" (BEECIFF), MEET, 2012. (in Bulgarian).
- Kaloianov N., D. Baev, D. Doukov. Energy management in small and medium enterprises, a practical guide.

MEASUREMENT OF PHYSICAL QUANTITIES

Semester: VII
ECTS credits: 6.0
Weekly workload: 2 + 0 + 2
Form of assessment: Written exam
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 „Measurement of Physical Quantities“ is included as compulsory discipline in the specialty curriculum „Metrology“. 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**.**

LASER TECHNIQUE

Semester: VII
Lecturer: Assoc. Prof. Luben Mihov Ivanov Ph.D.
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66, Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Physics
Status of the Subject: obligatory

Subject Description: The course considers the physical basics of laser technique and the principle of action of the most common laser sources. The physical principles of amplification and generation of light based on induced radiation are discussed. The course also describes laser resonators, principles of operation of gas and solid-state lasers as well as some tunable laser sources.

Specific Goals of the Subject: The course aims to familiarize students with the most modern light sources - lasers, which having some properties as coherence and great power and demonstrate their application in science and technology**.**

Pedagogical Methods: Lectures are visualized by demonstrations. During the seminar classes students solve varied problems on optics.

Preliminary Requirements: Basic knowledge in Optics and Mathematics.

Subsidiary Materials: Educational literature on Quantum electronics and Laser systems and printed materials on the topics given by lecturer.

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

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

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

ELECTROMAGNETIC COMPATIBILITY OF THE ELECTRONIC SYSTEMS FOR MEASUREMENT

Semester: VII
ECTS credits: 6.0
Weekly workload: 3 + 1 + 0
Form of assessment: Written exam

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 „Electromagnetic compatibility of the electronic systems for measurement“ is included as elective discipline in the specialty curriculum „Metrology“. 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 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. 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“ 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.

PREPARING THE PHYSICAL EXPERIMENT AND PROCESSING OF EXPERIMENTAL DATA

Semester: 7 semester
Cours Tipe: Lectures and laboratory exercises
Hours per week/FS/SS: 2 lecture hours, 2 laboratory hours per week/SS
ECTS credits: 6 credits
Lecturer: Assoc. Prof. Ralitsa Stanoeva, PhD
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66 Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Physics
Status of the Subject: Elective course

Subject Description: 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.

Specific Goals of the Subject: 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.

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

Requirements/Prerequisites: General knowledge in mathematical methods of physics and analysis

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

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

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

SPECTRAL DIAGNOSTIC METHODS IN BIOLOGY AND MEDICINE

Semester: VII
Lecturer: Assoc. Prof. Luben Mihov Ivanov Ph.D.
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66, Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Physics
Status of the Subject: Eligible

Subject Description: 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.

Specific Goals of the Subject: 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: Lectures are visualized by demonstrations. During the seminar classes students solve varied problems on optics.

Preliminary Requirements: Basic knowledge in Optics and Mathematics.

Subsidiary Materials: Educational literature on Medical physics and Optics and printed materials on the topics given by lecturer.

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

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

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

SPECTRAL ANALYSIS

Semester: VII
Hours (weekly): 2 hours lectures, 2- hours exercise
Course Type: Lectures
ECTS credits: 6.
Lecturer: Assoc. Prof. Atanas Chapkanov, PhD
Department: Chemistry, Faculty of Natural Sciences and Mathematics.
Course status: Optional

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, course work and final written exam

Registration for the exam: Coordination with lecturer and Students Service Department.

References (Bibliography):
Basic:
1. St. Spasov, M. Arnaudov, Application of spectroscopy in organic chemistry, Scien. Sofia, 1978.

2. G. Krischen, D. O'Reily, Instrumental Analysis (Bulgarian translation), ed. P. Bonchev, Sv. Kl. Ohridski, 1998
3. P. Shrajner, P. Fusson, D. Keptin, T. Morrill, "Identification of organic compounds"(in Russian), Moscow, 1983.
4. J. B. Lambert, E. P. Mazola. NMR_Spectroscopy. Pearson Eduaction Inc., 2001.
Additional:
5. H. Willard, L. Merritt, J. Dean, and F. Settle, Instrumental Methods of Analysis, 7th edition, van Nostrand Co., New York 1992. QD 79.I5.W54.
6. Eberhard Breitmaier. Structure Elucidation By NMR In Organic Chemistry: A Practical Guide. John Wiley & Sons, Ltd., 2002.

RADIOISOTOPE TOOLS FOR MEASURING, CONTROL AND AUTOMATION

Semester: VIII
ECTS credits: 5.0
Workload per week: 3 + 0 + 1
Evaluation Method: Written examination
Statute of the Subject: Elective course
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 Metrology. Students acquire basic knowledges about phenomena and specifics of using radioisotope equipment for measuring, control and automation in practice 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.

Course content: Physical fundamentals of radioisotope technique. Fundamentals of dosimetry. Radioisotope instruments. Applicability of radioisotope technology in industry. Features of the system design of radioisotopes automation. Basic concepts of Radiation Safety.

Pedagogical Methods and type of evaluation:

Basic knowledge on Nuclear Physics, Maths & Dosimetry 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 Radiation to Radiation Safety. Parts of topics with practical importance are directed to the laboratory classes.

The course is completed by a written examination. Some intermediate tests are conducted through the semester.

References:
- Gramatikov P. Nuclear Physics with elements of Radiation Protection and Dosimetry, N. Rilski Univ., Blagoevgrad, 2008 (in Bulgarian).
- Slavov B. Introduction in theoretical nuclear physics, St.. Kl. Ohridski Univ., Sofia, 2009 (in Bulgarian).
- Pugachev A., E. Sakharov. Guide on radioizotopnoy Automation, Energiya, Moscow, 1974. (in Russian).

- Balabanov N. Nuclear Physics, Plovdiv, 1998 (in Bulgarian).

PRACTICUM ON OPTICAL METHODS IN BIOLOGY AND MEDICINE

Semester: VIII
Lecturer: Assoc. Prof. Luben Mihov Ivanov Ph.D.
University/Faculty/Department: SWU "Neofit Rilsky"-Blagoevgrad; 66, Ivan Mihailov Blvd./ Natural Sciences & Mathematics/ Physics
Status of the Subject: Eligible

Subject Description: This practicum 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.

Specific Goals of the Subject: 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: Demonstrations and laboratory classes.

Preliminary Requirements: Basic knowledge in Optics and Mathematics.

Subsidiary Materials: Educational literature on Medical physics and Optics..

Evaluation Method: Current controlл.

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

Note: The practicum is suitable for students of all natural and technic

INTERACTION OF LASER RADIATION WITH MATTER

Semester: VIII
Type of presentation: Lectures and Praxis
Hours per week AS / SS: 2 Lecture hours / 2 Praxis / SS
ECTS Credits: 5
Lect/urer: Prof. Petar Petrov, PhD, D Sc, Assistant Prof. Darina Kaicheva
Department: Physics Department; Phone: +359887946199
Course Status: Elective course in the Physics Science B.Sc. Curriculum
Short Description: Introduction.

Course Aims: The students acquire basic knowledges about high-energy fluxes (HEFs), such as electron and photon beams and use its for welding, heat treatment, surface modification, fabrication of wear- and corrosion-resistant coatings, etc.

Teaching Methods: Lectures and Praxis. From the point of view material is arranged HEFs understanding these processes from both scientific and applied point of view.

Requirements/Prerequisites: Basic knowledge on General Physics & Mathematics.

Evaluation Method: Praxis Assessments A & Written final exam upon the lecture course.

Rating = 0,2.A+ 0,8 (Exam)

Inscribing for tuition: By request at the end of the previous semester.

Inscribing for exam: Agreement with the lecturer and the Students Service Department

References:

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)

LASER MATERIALS PROCESSING

Semester: VIII
Type of presentation: Lectures and Praxis
Hours per week AS / SS:2 Lecture hours / 2 Praxis / SS
ECTS Credits: 5
Lecturer: Prof. Petar Petrov, PhD, D Sc, Assistant Prof. Darina Kaicheva
Department: Physics Department; Phone: +359887946199
Course Status: Elective course in the Physics Science B.Sc. Curriculum

Short Description: Introduction.

Course Aims: The students acquire basic knowledges about high-energy fluxes (HEFs), such as electron and photon beams and use its for welding, heat treatment, surface modification, fabrication of wear- and corrosion-resistant coatings, etc.

Teaching Methods: Lectures and Praxis. From the point of view material is arranged HEFs understanding these processes from both scientific and applied point of view.

Requirements/Prerequisites: Basic knowledge on General Physics & Mathematics.

Evaluation Method: Praxis Assessments A & Written final exam upon the lecture course.

Rating = 0,2.A+ 0,8 (Exam)

Inscribing for tuition: By request at the end of the previous semester.

Inscribing for exam: Agreement with the lecturer and the Students Service Department

References:

- 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).
- V. Michailov, V Karhin, P. Petrov, "Baisic of welding", Stroitelstvo, 197p, (2012). (in Bulgarian)
- G. Mladenov "Electron and ion beam technologies" ,Marin Drinov, 387p , (2009). (in Bulgarian)

LEGAL PROTECTION OF INTELLECTUAL PROPERTY

Semester: VIII
ECTS credits: 5.0
Workload per week: 3 + 0 + 1
Evaluation Method: Written examination
Statute of the Subject: Elective course
Methodological guidance: Physics Department, Faculty of Natural Sciences & Maths
Lecturer: Kiril Iliev, Ph.D, Phone: +359 889 149 831

Annotation: The subject is an elective course studied by students to acquire a Bachelor degree. The students acquire basic knowledge about concepts and definitions of authorship on inventions and works, objects of intellectual property, various types of inventions and intangible objects that are not considered inventions, patents, the nature of utility models, objects that are not protected as utility models, geographical indications, marks and the rights to the trademark, industrial design, preventing unfair competition, licensing agreements, works of literature, art and science as objects of copyright, databases, works and all the objects that fall under the protection of intellectual property laws and so on. During the exercises students will be learning how to deal and solve problems concerning the separation of various intangible, recognized intellectual property. Different events of their violation and protection, how to fill registration documents to register objects recognized as intellectual property, and the administration which oversees the procedure and the interaction between national legislation relating to intellectual property rights, EU law, and the international law.

Course content: The course covers the following topics: Scope and method of legal protection of intellectual property. Intellectual property rights in the system of applicable law. Systems and principles of intellectual property law. Historical development of the protection of objects of intellectual property. Sources rules. Capacity and eligibility holders of intellectual property rights. Invention. Summary of the invention. Utility model. Copyright. The content and characteristics. Rights to works of literature, art and science as objects of copyright. Trademarks. Geographical indications. Protection of traditional knowledge, skills and expression. Design. Contracts related to intellectual property. Related rights - concept, types, origination, contract content. Prevention of unfair competition as an object of intellectual property. Review of European Union law and the legal protection of intellectual property in the EU, the role of the ECJ. International Legal Protection of Intellectual Property

Pedagogical Methods and type of evaluation: The lectures are held in the classical way. Students are introduced consistently with the current material. Provide Frontal issues, dialogue with the more active students and justify their opinions. From the methodological point of view the material is grouped in sections - the main categories of intellectual property and their expressions forms adequately protected by the measures provided for criminal, administrative and civil law matter. Each student works in an independent workplace and perform practical tasks described in the methodological guidelines and discussed in advance with the assistant. The course ends with an exam at the end of the semester, while the final grade reported results from the exam and evaluation of practical exercises and self-study (developed assignments).

References (all in Bulgarian)**:**

1. Pavlova, M. "Patent Law of the Republic of Bulgaria", Sofia, 2000.
2. Kamenova Ts. "International and national copyright", Sofia, 2004.

3. Illarionov, P., Zlatareva M. "Trademarks" Ciela Publishers, Sofia, 2006.
5. Sarakinov, G. "Copyright and Related Rights in the Republic of Bulgaria", 6 th ed., Publishing Sibi, Sofia, 2009.
6. Sarakinov, G. "Patent law in the Republic of Bulgaria", 5th ed., Publishing Sibi, Sofia, 2010.
8. Manchev, A.,. "Publishing contract" Ciela Publishers,, Sofia, 2012.

LANGUAGE CULTURE

ECTS: 2
Weekly classes: L-2; S-0; IL-2
Form of assessment: exam
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: Lectures and practical classes.

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