SPECIALITY : **PHYSICS**
MASTER PROGRAMME: **Energy Management and Sustainable Energy Development**
EDUCATIONAL QUALIFICATION DEGREE: **MASTER**
PROFESSIONAL QUALIFICATION : **MASTER IN PHYSICS**
DURATION : **4 SEMESTERS**
FORM : **REGULAR**

Master program on Energy Management and Sustainable Energy Development educates qualified professionals with knowledge for specific characteristics of different types of energy, for possible methods of reducing losses in its transformation, about methods and techniques to improve energy efficiency and environmental protection. Students are educated on principles of effective management of energy costs (*Energy Management*), role and working methods of energy service companies with guaranteed results (so-called *ESCO companies*) and to carry out investigation on energy efficiency of industrial plants (*Energy Audit*).

The program is of one year duration for students graduated in professional areas of "Natural sciences, Maths & Computing" and "Engineering" and of two years duration for graduates of other subjects. Graduate students can work as professionals and managers in energy, infrastructure and utility companies, as experts, managers and consultants in the public administration and NGO's, in divisions of the Sustainable Energy Development Agency (SEDA), in laboratories for environmental protection, base stations for environmental monitoring, in companies performing energy audits and using unconventional energy sources. They may occupy positions of an expert in scientific organization, a physicist, designer of energy installations, head of laboratory, research associate, assistant and lecturer at research institutes and universities after successfully passing competition.

CURRICULUM

Specialty : PHYSICS – code: 06.105_2.14.20

First year			
First semester	ECTS (credits)	Second semester	ECTS (credits)
Applied mathematics	12	Molecular physics	6
Mathematical methods of physics	6	Optics	6
Mechanics	6	Atomic and nuclear physics	6
Electricity and magnetism	6	Astrophysics	6
		Theoretical physics	6
	Total 30		Total 30
Second year			
Third semester	ECTS (credits)	Fourth semester	ECTS (credits)
Physical methods in environmental research	6	Enerjy management and sustainable energy development	5
Enerjy efficiency and competitiveness	6	Elective discipline group II	5
Elective discipline group I		Elective discipline group II	5
Elective discipline group I	6	State graduation examination in physics or	
Elective discipline group I	6	Diploma theses	15
	6		
Elective disciplines group I		**Elective disciplines group II**	
Physikal processes in nuclear power stations		Processes and Materials in High-Energy Fluxes Processing	
Specialised foreign language preparation		Photovolatic conversion of solar energy	
Solar architecture		Energetics and ecological problems	
Appleid thermotechics		Physics and management of the environment	
	Total 30		Total 30

TOTAL FOR TWO YEARS: 120 CREDITS

COURSES DESCRIPTION

Applied Mathematics

Course Title: Applied Mathematics
Semester: 1 semester
Course Type: lectures, tutorials and lab exercises
Hours per Week/FS/SS: 3 lecture hours, 2 tutorial hours and 2 lab hours per week/FS
ECTS Credits: 12 credits
Department: Informatics,
Course Status: Compulsory Course in the M.S. Curriculum of Energetics and Environment Protection
Course Description: The course includes:

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

Course Objectives: Students should obtain basic knowledge about numerical methods and theory of probability and mathematical statistics.
Teaching Methods: lectures, tutorials and lab exercises
Requirements/Prerequisites: Mathematical Analysis, Linear Algebra, Analytic Geometry, Differential Equations.
Assessment: written final exam covering problems /omitted in case the average grade of two current problem tests is higher than Very Good 4.50/ (grade weight is 30 %) and theory on two topics (grade weight is 30 %); two homework (grade weight is 20 %) and two projects (grade weight is 20 %)
Registration for the course: not necessary
Registration for the exam: coordinated with the lecturer and Student Service Department

References:

I. Basic titles:

1. B. Sendov, V. Popov – "Numerical Methods", Part I, St. Kliment Ohridski Sofia University Press, Sofia, 1996.
2. B. Boyanov – "Lectures on Numerical Methods", Sofia, 1995.
3. "Numerical Methods Problem Book", 2-nd ed., St. Kliment Ohridski Sofia University Press, Sofia, 1994.
4. M. Kaschiev – "Numerical Methods Handbook", Martilen, Sofia, 1994.
5. D. Bainov – „Theory of Probability and Mathematical Statistics", Impulse-M, Sofia, 1990.
6. B. Dimitrov, N. Yanev – "Probability and Statistics", Sofia, 1990.
7. B. Dimitrov, E. Karashtranova – "Statistics for Non-mathematicians", Blagoevgrad, 1993.
8. K. Kalinov – "Theory of Probability", Sofia, 2002.

II. Additional titles:

1. S.M. Stefanov – "Numerical Analysis", MS4004-2203, Limerick, 1998.
2. W. Feller – "Theory of Probability", Nauka and Izkustvo, Sofia, 1985 (in Bulgarian).

Mathematical Methods in Physics

ECTS credits: 6.0 **Hours per week:** 2 Lectures + 1 Seminar
Assessment: exam **Course Status:** Obligatory course in Physics M.S. Curriculum
Semester: I

Department of Physics
Faculty: Natural Sciences & Mathematics

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

Short Description: Main topics to be considered:

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

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

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

Mechanics

Title Mechanics	 No 3	**Semester** I
Type of presentation Lectures/ Seminars/Laboratory classes	**Hours per week)/ semester** 2 Lec./ 1 Lab.	**ECTS credits** 6

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

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

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

Preliminary Requirements: Basic knowledge in Physics and Mathematics.

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

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

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

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

Electricity and Magnetism

Title **Electricity and Magnetism**	No 4	Semester **I**
Type of presentation Lectures/ Seminars/Laboratory classes	**Hours per week** 2 Lec/ 1 Lab	ECTS credits 6

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

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

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

Preliminary Requirements: Basic knowledge in Physics and Mathematics.

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

Evaluation Method: Final examination in written form and subsequent conversation with the lecturer. Some intermediate tests conduct through the semester.

Inscribing for tuition: Not necessary.

Inscribing for exam: Agreement with the lecturer.

Molecular physics

Title Molecular physics	**№ 5**	**Semester II**
Type of presatotion Lectures/Laboratory	**Hours (per week)/ semester** 2 L/ 1 Lab/ winter	***ECTS credit*** 6

University/Faculty/Department: SWU "Neofit Rilski"-Blagoewgrad; 66, Ivan Mihailov Blvd/ Natural Sciences&Mathematics/ Department of Physics.
Status of the Subject: compulsory
Subject Description: The course is basic in the physical education and has two parts in the general physics – thermodynamics and molecular physics. They continues one semester and ends with an examination. The course combines the fondation of the reversible thermodynamics, statistical and thermodynamical treatment of its basic values, surface tension, viscosity difusion, physical acustics and elements of nonreversible thermodynamics.
Specific Goals of the Subject: The course gives to the students minimal knowledge required about the basic macroscopic physical phenomena in the region of the thermodynamics and molecular physics. The pracrical appliation of the knowledges is the object of treatment in the seminars and laboratory.
Pedagogical Methods: Lectures visualised by phsical demonstrations, seminars with decision of physical problems, laboratory classes. Some of the lectures are in a multimedia form.
Preliniuary Requirements: Basic Knowledge in mathematical analysis.

Subsidiary Materials: Educational literature on general physics (parts molecular physics and thermodinamics), printed materials on the sometopics, given wy the lectures to the sudents.
Evaluation Methods: Every part ends with written and oral examination. The results from the test examination during lectures, seminars and laboratory take place in the full evaluation.
Inscribing for tuition: Not necessary.
Inscribing for exam: Agreement with the lecturer .
Note: The lecture cuorse is convenient for Students of Physical, Chemistry and other natural and technical sciences.

Optics

Title **Optics**	No 6	Semester II
Type of presentation Lectures/ Seminars/Laboratory classes	**Hours per week)/ semester** 2 Lec./ 1 Lab.	ECTS credits 6

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.

Atomic and Nuclear Physics

Course Title: Atomic and Nuclear Physics
Semester: II
Type of presentation: Lectures / Laboratory classes
Hours per week / AS / SS: 2 Lecture hours / 1 Laboratory hour / SS
ECTS credits: 6

Department: Physics Department
Course Status: Compulsory course in the Physics M.Sc. Curriculum.

Short Description: Introduction to Atomic and Molecular Physics. Structure and Models of the Atom. Hydrogen Atom. Interaction of Atoms with Electromagnetic Radiation, External Electric and Magnetic Fields. Zeeman Effect. Intermolecular Interactions. Basic concepts of Nuclear Physics. Nuclear structure. Nuclear Forces. Isotopic Spin. Parity Violation, Neutron-Proton diagrams. Radiation α, β and γ. Nuclear models. Nuclear reactions. Neutron Physics. Fission. Fusion. Nuclear reactors. Basic concepts of Radiation Safety. Elementary particles.
Course Aims: The students acquire basic knowledges required about Atomic and Nuclear Physics. Material is selected depending of the specificity of the speciality. For that reason some specific topics are presented which are not included in the Physics programme for non-physical students.
Teaching Methods: Lectures are visualised by demonstrations and laboratory tasks performance during the laboratory classes. Exercises and case studies are decided at seminars. From methods point of view teaching material is grouped in sections by logical consistency from Structure of Atoms and Atomic and Nuclear Models to Nuclear Physics. Practical topics are directed to the laboratory classes.

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

Evaluation Method: Defence of the Labs Protocols L; Two intermediate tests K_1 and K_2 conduct through the semester; Written final exam upon the lecture course.

Rating: $= 0{,}2.L + 0{,}2.\left(\frac{K_1 + K_2}{2}\right) + 0{,}6\ (\text{Exam})$

Inscribing for tuition: Not necessary.
Inscribing for exam: Agreement with the lecturer and the Students Service Department

References:

1. Gramatikov P. S. *Atomic Physics*, N. Rilski Univ. Press, Blagoevgrad, 2007 (in Bulgarian).
2. Gramatikov P. S. *Nuclear Physics with elements of radiation protection and dosimetry*, N. Rilski Univ. Press, Blagoevgrad, 2008 (in Bulgarian).
3. Mandjukov I. *Experimental Nuclear Physics*, Sofia Univ-PhusFac., 2002
4. Balabanov N., M. Mitrikov. *Atomic Physics*, Sofia University Press "Kliment Ohridski", Sofia, 1991 (in Bulgarian)
5. Balabanov N. *Nuclear Physics*, Plovdiv Univ.Press, Plovdiv, 1998 (in Bulgarian)
6. A. Detlaf, B. Yavorskiy. *Course on Physics*, High School, Moscow, 1989 (in Russian)

Abbreviation:
AS: Autumn Semester; **SS**: Spring Semester

Asrtophysics

ECTS credits: 6 credits **Hours per week: 2 lecture hours, 1 seminar hours**
Assissment method: Examination **Course Status:** Compulsory subject
Semester: II
Methodical leadership:
Department of Physics
Faculty of Natural Sciences &Mathematics

Annotation:

The course "Astrophysics" has the task to acquaint the students with the basic methods and results in the nowadays astrophysics and gamma-astronomy of the ultra high energies and space physics. This is a new branch of the science, developed on the boundary between astronomy, cosmic rays physics and high and ultra high energy physics. Large scale detector complexes constructed on the base of scintillation, gas filled and cerenkov detectors, connected with complex logic and registering the data in real time are used.

A particular attention to the methods of mathematical modeling of electron-photon and photon-nuclear cascades and extensive air showers which are the main information carrier is given. The requested parameters and characteristics of the primary flux are estimated by solving complex inverse tasks with the help of modern mathematical methods.

The energy spectrum and the nuclear composition of the primary cosmic rays flux and its connection with the structure of the Universe and the processes going in it are analyzed.

A number of active astrophysical objects as local sources of primary gamma quanta, their photon spectrum and possible models, explaining the intensity and the time dependencies of the registered fluxes are examined.

As a whole the course "Astrophysics" should give the students a concept for the experimental technique and mathematical methods used in the present-days high-technology astrophysical complexes, to acquaint them with the actual problems and connections between the processes in the micro and macro space and with the modern ideas about the structure of the Universe ant the processes in it.

Course contents:

Lectures

Origin of the modern astrophysics and high energy gamma astronomy.
Universe, structure and basic processes in it.
Final stages in the evolution of stars.
Elementary interactions.
Strong interactions.
Electromagnetic cascade theory.
Nuclear cascade process.
Mathematical modeling of EAS.
Nuclear composition of primary cosmic rays flux.
Energy spectrum of primary cosmic rays flux.
EAS initiated by primary gamma quanta.
Cherenkov gamma telescopes.
Gamma quanta from compact extragalactic sources.

Teaching Methods and Assessment:

Two homeworks (marks D1, D2) and two written tests (marks K1, K2) are rated for continuous assessment during the semester. Only students with average rating from the continuous assessment greater than 3 are allowed to go on a examination.

The mark at the terminal examination (Exam) has the main weight in the final rating.

Rating = $0{,}05 \cdot \left(\frac{D1+D2}{2}\right) + 0{,}15 \cdot \left(\frac{K1+K2}{2}\right) + 0{,}8\ (Exam)$

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

Final grade calculation is done by using a 6-point rating scale: the rating 6 equals level A on ECTS; the rating 5 equals level B on ECTS; the rating 4 equals level C on ECTS; the rating 3 equals level D on ECTS; the rating 2 equals level E on ECTS.

REFERENCES:

1. Мурзин, **Введение в физику космических лучей**, Москва, Атомиздат 1979.
2. Hayakawa, **Cosmic Ray Physics**, New York, Interscience, 1969.
3. Hillas, A. M. **Cosmic Rays**, Oxford, Pergamont Press, 1982
4. Grieder P. , **Cosmic Rays At Earth - Researcher's Ref Manual And Data Book**, Elsevier, Amsterdam 2001
5. Dorman L. I., **Cosmic Rays in the Earth's Atmosphere and Underground**, Kluwer Academic Publishers, The Netherlands, 2004
6. Longair, M. S. **High Energy Astrophysics**, Cambridge Univercity Press, 2011

Theoretical physics

Course Title: " Theoretical physics"
Semester: 2 semester
Cours Tipe: Lectures and tutorials
Hours per week/FS/SS: 2 lecture hours, 1 tutorial hours per week/SS
ECTS credits: 6 credits

Department: Department of Physics
Course Status: Obligatory course in the B.S. Curriculum of physics
Short Description:

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

Course Aims: The course aims at giving fundamentals knowledge in theoretical Physics and to serve as a foundation for courses in theoretical physics, quantum electronics, astrophysics and other special courses.
Teaching Methods: lectures, tutorials, individual student's work
Requirements/Prerequisites: General knowledge in mathematical Analysis
Assessment Current evaluation at seminars and final written examination with discussion upon the end of the course.
Registration for the Course: by request at the end of the current semester (when is not obligatory course).
Registration for the Exam: coordinated with the lecturer and Students Service Department
References:

Basic

1.Д.Трифонов, Класическа електродинамика, Изд-во ЮЗУ, Благоевград, 1995.

2.Х.Попов, Електродинамика, “Наука и изкуство”, София, 1987.
3.А.Атанасов, Основи на квантовата механика, Изд.Пловдивски У-тет, 1993.
4.С.Иванов, Основи на теоретичната и квантова механика, Изд. Софийски У-тет, 1998
5.И.Златев, А.Николов, Теоретична механика Наука и изкуство, София, 1985..
6.Ч.Кител, Х.Кремер, Статистическа термодинамика**, “**Наука и Изкуство София, 1988
Additional
11.Л.Ландау, Е.Лившиц, Електродинамика, Механика, Квантовая механика, “Наука”, Москва, 1976.

Physical Methods in Environmental Research

ECTS credits: 6 credits **Hours per week: 2 lecture hours, 2 laboratory hours**
Assissment method: Examination Course Status: Obligatory

Semester: III

Methodical leadership:
Department of Physics
Faculty of Natural Sciences &Mathematics

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. The students in physics have to receive ground knowledge about using the contemporary physical methods in the monitoring of the environment.

Course contents:
Modern physical problems in the protection and control of environmental parameters.
Distribution and properties of water on the globe, and in living organisms. Water balance in the hydrosphere.
Anomalies in the physical properties of water and their importance for the energy balance of the earth and the development of living organisms.
Structure of water - models. Spectral properties of different ranges. Spectrum of the energy distribution of the intermolecular bonds in water and method for obtaining it.
Ionization of water - pH and pK. Water as a solvent. Acid rains and their neutralization.
Physical methods for activation of water. Activation of water by turbulent motion, motion in a gradient magnetic field and by electrolysis through a membrane filter.
Aerosols and pollutions on atmosphere. Physical properties and methods of studying aerosols
Atmospheric Optics. Basic optical phenomena and methods for their study. Optical absorption and scattering. Lidar systems.
Spectrum of solar radiation. Laws of thermal radiation. Photovoltaic inverters on solar energy. Water and wind sources of energy. Bioenergy.
Anthropogeneous sources of energy. Heat sources on based of natural fuels. Nuclear sources. Hydrogen Energy.
Transport of pollutions in the atmosphere and hydrosphere. Diffusion, hydrodynamic transmission turbulence.
Spectroscopy of the environment. Atomic, molecular, Raman spectroscopy and X-ray. Global approach for monitoring on pollutions of the upper atmosphere by artificial satellites on Earth.
Radioactive contaminations of the environment. Radiation monitoring of the atmosphere, earth, water sources and biological species.
Noise pollution of the environment. Sound level, monitoring, problems for the noise insulation.

Impact of noise on the human psyche. Psycho-physical mechanism of sound pollution.

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.

The students' extra-curriculum activity represents the preparation and presentation of a scientific experimental research; conducting physical studies; testing

Help Materials:

1. E.Bocker, R.Van Gondelle, Enviromental Phisics, John Wiley and Sons, N.Y., 1996.
2. Д.Митчел, Д.Смит, Аквametрия, Химия, Москва, 1986.
3. А.Хргиан, Физика атмосферы, Изд. Московского у-та, Москва, 1986.
4. А.Грицков, Фотометрия, Спектрофотометрия, Колориметрия, изд.СУ, София,2000.
5. Г. Василев, Химия и опазване на околната среда, УИ „Св. Климент Охридски", София, 2007.

Assessment:

The **assessment** of the students' results is done accordingly to the ECTS. The final rating is formed at the end of the course on the basis of the rating of a written test on all topics mentioned above, on the basis of the rating of the student's routine control and on the basis of the rating of the student's extra-curriculum activity in the following ratio.

ENERGY EFFICIENCY AND COMPETITIVENESS

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

Course Status: Compulsory course of the Physics Science M.Sc. Curriculum
Short Description: European energy policy. Energy balance of the country. State and municipal
energy efficiency policy. Energy efficiency in transport, industry and households. Ways of financing energy efficiency projects.
Course Aims: To introduce the students of Physics with the basic principles of energy efficiency
of the economy and its impact on other sectors of the economy.
Teaching Methods: Lectures and Praxis. Students will prepare presentations on the content of the
lectures. There will also be a written exam of knowledge.
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. I. Iliev, N. Kaloyanov, P. Gramatikov,... *Energy Efficiency & Energy Management handbook*,
Ruse University, Ruse, 2013.

2. *Energy and good management, trends and policies*, (Ed. O. Shentov & al.), Center for Study of
Democracy, Sofia, 2011.
3. Nigel M. and P. Hughes: *Introduction to Environmental Physics: Planet Earth, Life and Climate*, Taylor and Francis, 2001.
4. Evaluation of energy efficiency in the EU-15 Indicators and measures, ADEM Editions, Paris,
2007.

ENERGY MANAGEMENT AND SUSTAINABLE ENERGY DEVELOPMENT

Semester: IV
Type of presentation: Lectures and Praxis
Hours per week AS / SS: 2 Lecture hours / 2 Praxis / SS
ECTS Credits: 5
Department: Physics Department

Course Status: Compulsory course of the Physics Science M.Sc. Curriculum
Short Description: Types of Energy. Effective management of energy consumption. Types of
energy audit. Energy management in lighting installations, compressor, boiler and cogeneration
systems. Determining energy savings and greenhouse gas emissions.
Course Aims: To provide students with specialized knowledge for solving of basic problems and
solutions for effective management of energy consumption in different areas of the economy.
Teaching Methods: Lectures and Praxis. Students will prepare presentations on the content of the
lectures. There will also be a written exam of knowledge.
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. I. Iliev, N. Kaloyanov, P. Gramatikov,... *Energy Efficiency & Energy Management handbook*,
Ruse University, Ruse, 2013.
2. Kaloyanov N., D. Baev, D. Dukov. „*Energy Management in SME*", Handbook.
http://www.ems-textile.eu/files/Energy_Management_Manual_BG.pdf
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.
Abbreviation:
AS: Autumn Semester
SS: Spring Semester

PHYSICAL PROCESSES IN NUCLEAR POWER STATIONS

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

Course Status: Elective course in the Physics Science M.Sc. Curriculum
Short Description: 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.
Course Aims: 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.
Teaching Methods: Lectures and Praxis on Nuclear Power Stations.
Requirements/Prerequisites: Basic knowledge on General, Atomic, Nuclear and Thermal Physics.
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. Gramatikov P. *Nuclear Physics with elements of Radiation protection and Dosimetry,* SWU,
Blagoevgrad, 2008.
2. Gluhov G., M. Lakov. Fundamentals of Nuclear Engineering, Ciela, Sofia, 2011.
3. Lakov M., Gluhov G. *Nuclear reactors and steam generation plants,* Ciela, Sofia, 2011.
Abbreviation:
AS: Autumn Semester
SS: Spring Semester

Specialized preparation in a foreign language

Course Title: Specialized preparation in a foreign language

Semester: 1. (winter) semester

Course type: Seminars, out-of-class work

Hours per week: 4 seminar hours

ECTS credits: 6 credits

University/Faculty/Department: Sowthwest University “Neophit Rilsky”, Blagoevgrad, 66 bul. Ivan Michailov, Science and Mathematics Faculty, Department of Physics

Statute of the discipline in the curriculum: Optional

Description of the discipline: The discipline “Specialized preparation in a foreign language” is constructed as a necessary component of the whole preparation of future physicists with a master degree. The course aims at broadening of the foreign language preparation by

enriching it with general and special science vocabulary and showing the ways of its specific uses in different texts – abstracts, articles, announcements, monographs, textbooks in physics.

Course objectives: The main objective of the course is the students, to enrich their science vocabulary, to acquire some basic skills to comprehend and interprete different scientific texts, and to know how they are prepared.

Teaching methods: Seninars, individual student out-of-class work

Requirements/Prerequisites: Basic knowledge of English

Assessment: Permanent control, written test.

Registration for the course: It is necessary to apply in the administrative department during the previous semester

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Solar architecture

Subject **Solar architecture**	**No 5**	**Semester** **1 semester**
Type of lecture Lectures/Seminars	**Hours (Week) / semester** 2 L / 2S / Winter semester	**Credits** 6.0

University/Faculty/Department: SWU "Neofit Rilski", Blagoevgrad, Ivan Michailov 66/ Mathematics & Natural Science Faculty "Computer systems and technologies"

Status of the Subject: Optionally Subject

Description of Subject:

- Solar Energy. Thermal solar applications.
- Passive solar systems. Types of passive solar systems.
- Direct passive solar systems. Efficient building orientation and form.
- Indirect Passive solar systems.

Specific goals of Subject:
Students will acquire knowledge for modern building technologies and practical experience to use this system.

Pedagogical methods:
Lectures will be visualized by tables, slides and presentations. In seminar exercises a real computer application will be observed and simple examples will be developed.
Preliminary requirements
Basic knowledge in heat physics and mechanics.

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

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

APPLIED THERMOTECHICS

Semester: III
Type of presentation: Lectures and Praxis
Hours per week AS / SS: 2 Lecture hours / 2 Praxis / AS
ECTS Credits: 6
Department: Physics Department
Course Status: Elective course in the Physics Science M.Sc. Curriculum
Short 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.
Course Aims: 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.
Teaching Methods: Lectures and Praxis. From the Methods point of view material is arranged from
Thermal motors and machines via Building Physics to the Energy efficiency and environmental
protection.
Requirements/Prerequisites: Basic knowledge on General Physics & Mathematics.
Evaluation Method: Defence of the Praxis Assessments A & Written final exam upon the lecture
course.
Rating: = 0,2.A + 0,* (Exam)
Inscribing for tuition: By request at the end of the previous semester.
Inscribing for exam: Agreement with the lecturer.
References:
1. Gramatikov P. *Lectures on Applied Thermotechnics*, SWU-Blagoevgrad, 2012 (in Bulgarian).
2. Dimitrov A. *Modern Heating Technology and Energetics*, Sofia, 2011, (in Bulgarian).
3. Hadjigenova N. *Thermal part of TPP*, Technics, Sofia, 1979 (in Bulgarian).
4. Baskakov A., Berg B, Vitt O. *Thermotechnics*, Energoizdat, Moscow, 1982 (in Russian).
Abbreviation:
AS: Autumn Semester
SS: Spring Semester

Processes and Materials in High-Energy Fluxes Processing

Semester: IV
Type of presentation: Lectures and Praxis
Hours per week AS / SS: 2 Lecture hours / 2 Praxis / SS
ECTS Credits: 5

Department: Physics Department

Course Status: Elective course in the Physics Science M.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, 387p , (2009). (in Bulgarian)

Abbreviation:
AS: Autumn Semester
SS: Spring Semester

Photovoltaic conversion of solar energy

Subject **Photovoltaic conversion of solar energy**	**No 1**	**Semester** **2 semester**
Type of lecture Lectures/Seminars	**Hours (Week) / semester** 2 L / 2S /Summer semester	**Credits**

University/Faculty/Department: SWU "Neofit Rilski", Blagoevgrad, Ivan Michailov 66/ Mathematics & Natural Science Faculty "Physics"

Status of the Subject: Optional Subject

Description of Subject:

1. Physical principles of solar energy conversion. Photovoltaic conversion of solar energy.
2. Introducing in technology for photovoltaic panels. Thin layers. Semiconductor materials.
3. Electricity generation in photovoltaic elements. Energy efficiency of photovoltaic converters.
4. Materials for photovoltaic panels. Silicon – amorphous and crystal structure. Photovoltaic converters based on organic materials.
5. I – V diagram of Photovoltaic elements. Experimental and testing equipment for PV.
6. Solar PV Installations. Photovoltaic controllers (inverters).
7. Application of PV elements. Link with the conventional electricity net.

8. Ecological problems in solar energy applications.

Specific goals of Subject:
Students will acquire knowledge for modern solar technologies and practical experience to use this system.

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

Preliminary requirements
Basic knowledge in mathematics and physics.

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

ENERGETICS AND ECOLOGICAL PROBLEMS

Semester: IV
Type of presentation: Lectures and Praxis
Hours per week AS / SS: 2 Lecture hours / 2 Praxis / SS
ECTS Credits: 5
Department: Physics Department
Course Status: Elective course in the Physics Science M.Sc. Curriculum
Short Description: Introduction. Thermal motors and machines. Organic fuels. Processes and products of combustion. Industrial and power boilers. Thermal and Nuclear power plants. Basics of
the Building Physics. Energy efficiency and environmental saving. Kyoto Protocol and Energy
Efficiency Act.
Course Aims: The students acquire basic knowledges about methods of effective output, transformation, transfer and use of energy from conventional and alternative sources, as well as
with methods for environmental protection and legislative framework for that.
Teaching Methods: Lectures and Praxis. From the Methods point of view material is arranged
from Conventional & Alternative Energy Sources via Energy efficiency and environmental protection to the legislative framework for that.
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. Girardet H. & M. Mendonca. *A Renewable World – Energy, Ecology, Equality*, Green Books
Ltd, UK, 2009.
2. Saxena A. B. *Textbook of Energy, Environment, Ecology and Society*, New Age Int., 2011.
3. Hadjigenova N. P. *Thermal Part of TPP*, Technics, Sofia, 1979 (in Bulgarian)
4. Anderson B. *Solar Energy,* Strojizdat, Moscow, 1982 (in Russian)
5. *Energy Efficiency Act*, St. Gazette, Sofia, № 59, 05.07.2013 г. (in Bulgarian)

PHYSICS AND MANAGEMENT OF THE ENVIRONMENT

Semester: IV
Type of presentation: Lectures and Praxis
Hours per week AS / SS: 2 Lecture hours / 2 Praxis / SS
ECTS Credits: 5
Department: Physics Department
Course Status: Elective course in the Physics Science M.Sc. Curriculum
Short Description: Introduction. Climate. Solar radiation, ocean and climate. Clouds and aerosols.
Greenhouse effect. Wind energy. Geophysics. Energy efficiency and environmental protection.
Kyoto Protocol and Energy Efficiency Act.
Course Aims: To introduce the students of Physics with the basic Physical laws governing atmospheric processes and methods of environmental and legal frameworks in this area.
Teaching Methods: Lectures and Praxis. From the Methods point of view material follows a logical sequence from Physical factors determining the atmosphere via the basic Physical laws of
Geophysics to the legal commitments of Bulgaria under the Kyoto Protocol and the Energy Efficiency Act.
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. Girardet H. & M. Mendonca. *A Renewable World – Energy, Ecology, Equality*, Green Books
Ltd, UK, 2009.
2. Saxena A. B. *Textbook of Energy, Environment, Ecology and Society*, New Age Int., 2011.
3. Nigel M. and P. Hughes: *Introduction to Environmental Physics: Planet Earth, Life and Climate*, Taylor and Francis, 2001.
4. Anderson B. *Solar Energy,* Strojizdat, Moscow, 1982 (in Russian)
5. *Energy Efficiency Act*, St. Gazette, Sofia, № 59, 05.07.2013 г. (in Bulgarian)
Abbreviation:
AS: Autumn Semester
SS: Spring Semester