SPECIALITY : **PHYSICS**
MASTER PROGRAMME: **Energy Management and Sustainable Energy Development**
EDUCATIONAL QUALIFICATION DEGREE: **MASTER**
PROFESSIONAL QUALIFICATION : **MASTER IN PHYSICS**
DURATION : **2 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_1.14.20

First year

First semester	ECTS (credits)	**Second semester**	ECTS (credits)
Physical methods in environmental research	6	Enerjy management and sustainable	5
Enerjy efficiency and competitiveness	6	energy development	5
Elective discipline group I		Elective discipline group II	5
Elective discipline group I	6	Elective discipline group II	
Elective discipline group I	6	State graduation examination in physics or	15
	6	Diploma theses	
Elective disciplines group I		**Elective disciplines group II**	
Technical thermodynamics		Photovoltaic conversion of solar energy	
Applied thermal physics		Processes and Materials in High-Energy	
Specialised foreign language preparation		Fluxes Processing	
Solar architecture		Energy production and ecological problems	
		Physics and management of the environment	
	Total 30		Total 30

TOTAL FOR ONE YEAR: 60 CREDITS

COURSES DESCRIPTION

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: I

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, Аквaметрия, 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.

Course Title: ENERGY EFFICIENCY AND COMPETITIVENESS
Semester: I
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: 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.
Abbreviation:
AS: Autumn Semester
SS: Spring Semester

Course Title: TECHNICAL THERMODYNAMICS
Semester: I
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: Introduction. Basic principles of Thermodynamics. Thermodynamical processes.
Cycles of heat engines and machines.
Course Aims: Students acquire basic knowledges about Basic principles of Thermodynamics,
transformation, transfer and use of heat, as well as with principles of action of heat engines and
machines.
Teaching Methods: Lectures and Praxis. From the Methods point of view material is arranged from
thermodynamic principles and processes to applied topics..
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 + 0,8 (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 Thermal Physics*, SWU-Blagoevgrad, 2012 (in Bulgarian).
2. Velev D. *Technical Thermodynamics and heat transfer*, Ruse University, 1981 (in Bulgarian).
3. Baskakov A., Berg B, Vitt O. *Thermotechnics*, Energoizdat, Moscow, 1982 (in Russian).
4. Krastev, J., V. Markov, Chotorov D. *Technical Thermodynamics and Heat Transfer*, Technics,
Sofia, 2004 (in Bulgarian).
Abbreviation:
AS: Autumn Semester
SS: Spring Semester

Course Title: APPLIED THERMAL PHYSICS
Semester: I
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: Entropy. Basic concepts of Heat-Mass-Transfer. Conduction, convection, radiation. Complex thermal transfer. Applied Thermotechnics.

Course Aims: 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.
Teaching Methods: Lectures and Praxis. From the Methods point of view material is arranged from
Thermal motors and machines via heat-mass transfer to applied topics.
Requirements/Prerequisites: Basic knowledge on General Physics & Mathematics.
Evaluation Method: Defence of the Praxis Assessments P; Two intermediate tests K1 and K2 conduct
through the semester; 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.
References:
6. Gramatikov P. *Lectures on Thermal Physics*, SWU-Blagoevgrad, 2012 (in Bulgarian).
7. Dimitrov A. *Modern Heating Technology and Energetics*, Sofia, 2011, (in Bulgarian).
8. Velev D. *Technical Thermodynamics and heat transfer*, Ruse University, 1981 (in Bulgarian).
9. Baskakov A., Berg B, Vitt O. *Thermotechnics*, Energoizdat, Moscow, 1982 (in Russian).
10. Miheev M., Miheeva I. *Fundamentals of heat transfer*, Energoizdat, Moscow, 1977 (in Russian).
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

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.

Note: Lection course is useful for students of all natural science specialties.

Course Title: ENERGY MANAGEMENT AND SUSTAINABLE ENERGY

DEVELOPMENT
Semester: II
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

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.

Course Title: Processes and Materials in High-Energy Fluxes Processing
Semester: II
Type of presentation: Lectures and Praxis
Hours per week AS / SS: 2 Lecture hours / 2 Praxis / SS
ECTS Credits: 5

Department: Physics Department; Phone: +359887946199;
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

Course Title: **ENERGETICS AND ECOLOGICAL PROBLEMS**
Semester: II
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)
Abbreviation:
AS: Autumn Semester
SS: Spring Semester

Course Title: PHYSICS AND MANAGEMENT OF THE ENVIRONMENT
Semester: II
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
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