BSU Course "Energy Effective Materials"

Chair of Energy Physics

General data

Code	
Course title	Energy Effective Materials
Course status in the programme	Compulsory
Course level	Undergraduate Studies
Course type	Academic
Field of study	Material Science/specialization “Energy Physics”/skill “Physicist. Engineers”
Responsible instructor	Alexander Fedotov
Academic staff	Alexander Mazanik Mikhail Tivanov
Volume of the course: parts and hours	1 part, 42 academic hours
Language of instruction	RU
Possibility of distance learning	Not planned
Abstract	It is the completing course on material science. It includes the study of structure and properties of non-metallic materials for power industry and energy saving, materials for alternative power industry and renewable energy sources and energy efficient walling materials.
Goals and objectives of the course in terms of competences and skills	To demonstrate to students the fundamental ideas and principles how to manufacture and use materials in power industry, energy saving and renewable sources of energy.
Structure and tasks of independent studies	At home must be prepared 15 tests, solved 2 problems and written 1 essay from 4 main parts of the course within the framework of Controlled Independent Work (CIW) of students
Recommended literature	A.K. Fedotov. Physical Material Science. Part 1. Solid State Physics. Minsk, High Education School, 2010. 400 pp.; The e-books “Energy Efficient Materials“; Fistul V.I. Physics and Chemistry of Solids. Parts 1 и 2. Moscow, Metallurgy, 1995. 543 pp.
Course prerequisites	Fundamentals of general physics and mathematics, quantum mechanics, thermal dynamics, statistical physics
Courses acquired before	Basics of material sciences

Course outline

Theme	Hours
Lectures	
Introduction. The role of new materials in the power industry and energy saving. The impact of new materials for improving the efficiency in power industry, facilities and technologies.	2
Structure and properties of non-metallic materials for power industry and energy saving. Inorganic non-metallic materials and their classification. Glasses. Ceramics.	4
Organic materials and their classification. Polymers. Plastics. Wooden materials.	4
Composite materials and their classification. Principles for selection of the matrix and filler materials, the reinforcing phases and structure of composite.	2
Particulate-reinforced, fiber-grained, layered and other composite materials. Properties and applications of composite materials in the power industry and energy saving.	2
Materials used in alternative and renewable energy sources. Materials for nuclear power stations. Materials for protection against hard radiation.	2
Thermoelectric materials in power industry.	2
Materials for batteries. Requirements for components of the battery. Materials for the anode and cathode. Solid electrolytes.	2
Materials for hydrogen power industry. Hydrogen accumulators. Fuel elements. Metal-hydride battery. Hydrogen embrittlement.	2
Materials in geothermal power industry. Interaction of materials with geothermal fluids. Corrosion and erosion in geothermal systems.	2
Superconducting materials and their application in power industry.	2
Photovoltaic materials: silicon, cadmium telluride, semiconducting films.	2
Materials for solar collectors.	2
Materials with special properties of reflection and absorption of electromagnetic radiation	2
Efficient walling materials. Construction inorganic materials (concrete, reinforced concrete).	4
Inorganic construction materials (ceramics, composites).	4
Wooden materials. The structure and chemical composition. Physical and mechanical properties	2

Learning outcomes and assessment

Learning outcomes	Assessment methods
To understand the basic ideas and approaches to manufacturing of materials for power industry, energy saving and renewable sources of energy	Ability to solve corresponding problems
To understand main functional properties of non-metallic materials used in power industry, energy saving and renewable sources of energy	Ability to solve corresponding problems
To understand main functional properties of materials used in alternative power industry and renewable sources of energy	Ability to solve corresponding problems

To understand main functional properties of construction materials for envelopes	Ability to solve corresponding problems
To be able to execute 15 short tests by 15 lectures (consisting of 5 questions every)	To give the right answers on 4 of 5 questions
To be able to execute 2 written tests (consisting of 3 questions every)	To give the right answers on 2 of 3 questions
At home must be done 1 essay	Successfully written home essay

Study subject structure

Part	Semester		Hours per semester			Tests				CIW
	Autumn	Spring	Lectures	Practical	Lab.	Short test	Written test	Essay	Exam	
1.	+	-	34	-	-	+	+	+	+	8