**Name of the course:** Functional materials for security systems

**Department responsible for the course or** **equivalent:** Dpt. Technosphere safety and chemistry, Institute of Nanotechnologies, electronics and electronic equipment engineering

**Lecturer (name, academic title, e-mail): Dr. Tatiana Semenistaya,** [**semenistayatv@sfedu.ru**](mailto:semenistayatv@sfedu.ru)

**Semester when the course unit is delivered**: 3

**Teaching hours per week**: 3

**Level of course unit**: Master's Level

**ECTS credits:** 5

**Admission requirements**: Course «Functional materials for security systems » requires the basic knowledge of material science (the relationship between composition, structure and properties materials and patterns of their changes with external physicochemical impacts), general and solid state physics, chemistry and material science. To study this academic discipline, the following knowledge and skills formed by previous discipline are necessary: "Designing systems for ensuring technosphere safety". Knowledge: principles of work, technical characteristics, design features of the developed and used structures of devices, devices and equipment elements of protective and treatment facilities. Skills: apply the knowledge obtained in the study of previous disciplines; find the necessary information in educational literature and information sources; analysis and systematization of information; environmental monitoring.

**Course aims**: To obtain a general understanding of high-tech materials for security systems, their properties, production methods and applications, as well as the study of the scientific basis for creating new devices, their elements and materials for environmental monitoring.

The « Functional materials for security systems» course is taught in the 3rd semester of Master’s program.

**Course contents**:

The course is comprised of 2 units (and a UNIT 0).

Unit 0. Introduction The concept of functional materials. General characteristics of functional materials. Types of functional materials.

Unit 1. Modern functional materials and their properties. Inorganic substances and materials. Metals and materials based on them. Metal fibers, metal plastics, metal polymers. New forms of carbon and materials based on them. Glassy inorganic materials. Thin films and coatings. Ceramics. Composites. Organic substances and materials. Polymer semiconductors, conductors and photoconductors. Polymer composite materials. Fiberglass, carbon fiber, organoplastic. Organic metals.

Nano-substances, nanomaterials. Nanostructured metals and alloys with special mechanical properties. Nanostructured ceramic and composite materials and coatings. Sensory composites. Composite materials. Construction materials. Supermolecules and supramolecular assemblies. Molecular recognition. Self-organization, self-regulation and replication ability of supramolecular systems. Supramolecular materials.

Unit 2. The use of functional materials. Inorganic substances and materials in science and technology. Organic substances and materials in science and technology. Nano-substances, nanomaterials, nanotechnologies. Supramolecular systems in science and technology.

**Learning outcomes**: Students will give an oral presentation on a current topic in area of functional materials for security systems.

**Planned learning activities and teaching methods:** Lectures, Presentation Work.

**Assessment methods and criteria**

Assignments for this course consists of: 4 projects, a midterm and final exams, and an end of term presentation.

1. Questioning students 20%

2. Presentation in class 10 min pres. and 5 min Q&A 40%

3. Final Exam 40%

**Course literature (recommended or required):**

1. M. Chizhova. Technology of composite materials and products. / M.A. Chizhov; A.P. Chizhov; A.I. Krivorotova - Krasnoyarsk: SibGTU, 2012. - 44 p. http://biblioclub.ru/index.php?page= book & id = 428849

2. Nesterov A. A. Modern problems of materials science of ceramic piezoelectric materials / A.A. Nesterov; A.A. Panich - Rostov-on / D: Publishing House of the Southern Federal University, 2010. - 226 p. http://biblioclub.ru/index.php?page= book & id = 241139

3. Structural and functional materials on a metal base / V.M. Farber - Ekaterinburg: Ural University Press, 2014. - 252 p. http://biblioclub.ru/index.php?page= book & id = 275738