

UNIVERSITY OF CHEMICAL TECHNOLOGY AND METALLURGY  
FACULTY OF METALLURGY AND MATERIALS SCIENCE  
CENTRE OF MATERIALS SCIENCE

**Confirmed by:**

**Dean:**

/Assoc. Prof. PhD eng. I. Gruev/

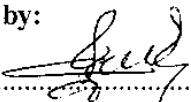
**EDUCATIONAL PROGRAM**


**Discipline (Optional, Group A): "Amorphous and glassy semiconductors"**


**Subject: "Materials Science"**

**Educational degree: Magister**

**Prepared by:**

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**Centre of Materials Science**

**Head of the centre:**.....  
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**S O F I A, 2006**

**EDUCATIONAL PROGRAM**

For the discipline "Amorphous and glassy semiconductors"

### I. Number of lessons within the educational program

№	Educational type	Semester	Number of lessons	
			Weekly	Total
1.	Lectures	III	10	30
2.	Exercises: - laboratories - calculations	III		10 10
3.	Form of control	Exam.		

### II. Annotation

The educational course presented for attendance is new. It is a modern sector of semiconductor materials knowledge, which discusses the production, the properties and the applications of a new class of materials: amorphous (glassy) semiconductors.

The educational course discusses 13 separate subjects arranged in four sections: a) amorphous and glassy non-organic substances; b) amorphous and glassy systems; c) electric and optical properties of glasses and amorphous substances; d) application of amorphous and glassy semiconductors.

The modules contain 4 separate exercises, which come to illustrate the material from the lectures and which are of key importance in the investigated discipline: defining the sphere of glass formation in the triple chalcogenide system (a research exercise), production of glass-formed phases and investigation of their major characteristics; defining the dissolution kinetics of chalcogenide glasses.

The course is organized for students, who have shown interest in semiconductor materials knowledge and who will most probably undertake scientific research activities in this particular sphere.

### III. Lecture courses

#### Section I. Amorphous and glassy state of non-organic substances

1. Methods for producing amorphous solids and glass (producing ChG from smelting. Producing amorphous solids from solutions. Production of amorphous layers from gas phase. Transformation of crystal substances into an amorphous state). 2 hours

2. Thermodynamic description of the glassy state (relaxation processes in liquid and glass formed substances. Temperature of transformation into glass. Thermodynamic functions and glass formation). 3 hours

3. Phase transitions and glass formation (phase separation from the glass formation smelter. Critical speed of cooling and glass formation tendencies). 2 hours

4. Structure of the chemical connection in glass and amorphous solids (basic methods for investigating the structure of non-crystal solids. Structural theories of glass formation. Correlation: structure and properties). 4 hours

5. Electronic states of non-crystal solids (the zone model and localization of electrons in solids).  
Autonomous disorientation and charging of defective centres of non-crystal systems).  
3 hours

### **Section II. Amorphous and glassy semiconductors**

6. Non-crystal modifications of the elements. Alloys (Metal glass. Non-metal elements in amorphous state. Glass formation of halogenates). 2 hours

7. Double glass formation compounds and systems (oxide and halogenate systems based on boron, phosphorus, arsenic, antimony, silica and germanium. Glass forming fluorides).  
2 hours

8. Triple glass formation halogenate systems (oxihalogenates. Triple halogenate systems with two metal or two halogenate elements, etc.). 2 hours

9. Methods for the investigation of amorphous and glass-formation substances. 2 hours

### **Section III. Electrical and optical properties of amorphous and glassy semiconductors**

10. Transfer of charges into non-crystal solids. Glass with ion and electronic conductivity.  
Electrical conductivity of glass and amorphous solids with a weak connection polarity. Mobility of charges. Photoconductivity. 2 hours

**Subject 11.** Optical features. Absorption and transfusion. Photoluminescence. Light refraction coefficient. Photo induced transformation in ChG. 2 hours

### **Section IV. Application of amorphous and glassy semiconductors**

12. Solar elements based on Si and alloys. Switchers. Diodes and transistors. Ion-selective Electrodes. 2 hours

13. Image forming devices (environment for information recording). Electrographic applications (xerography). 2 hours

## **IV. Practice**

1. ChG synthesis and setting the sphere of glass formation in a three component system. 3 hours
2. Defining the thermal and thermo-mechanical characteristics of the ChG 3 hours
3. Defining the density and micro-hardness of a ChG 2 hours
4. Defining the kinetics and dissolution of ChG in KON 2 hours

## **V. References**

1. Adalbert Feltz, Amorphe and glasartige anorganische Festkoerper, Akademie Verlag, Berlin (1983)
2. Elliott S.R., Physics of Amorphous Materials, London New York, Longman (1983)
3. Jai Singh, Advances in Amorphous Semiconductors, CRC; 1 edition (May 1, 2003)
4. Kazuo Morigaki, Physics of Amorphous Semiconductors, World Scientific Publishing Company (July 1999)
5. Y. Hamakawa, Amorphous Semiconductor Technologies & Devices, Elsevier Science Publishing Company (January 1985)