South-West University "Neofit Rilski"

FACULTY OF MATHEMATICS AND NATURAL SCIENCES

Department of "Chemistry"

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INFO PACK

/ECTS/

FIELD OF HIGHER EDUCATION: **4. NATURAL SCIENCES, MATHEMATICS AND INFORMATICS**
PROFESSIONAL DIRECTION: **4.2. CHEMICAL SCIENCES**
DOCTORAL PROGRAM: **INORGANIC CHEMISTRY**

QUALIFICATION CHARACTERISTICS OF DOCTORAL PROGRAM "INORGANIC CHEMISTRY"

EDUCATIONAL AND SCIENTIFIC DEGREE: **DOCTOR**
TERM OF STUDY**: 3 / three / or 4 / four / years**
FORM OF TRAINING: **REGULAR / INDEPENDENT**

The doctoral program in Inorganic Chemistry from professional field 4.2. Chemical Sciences provides an opportunity to obtain the third educational and scientific degree of higher education "Doctor". The doctoral program "Inorganic Chemistry" is administered by the Department of Chemistry, at the Faculty of Natural Sciences and Mathematics of SWU "Neofit Rilski". The qualification characteristics and the curriculum of the doctoral program "Inorganic Chemistry" are in accordance with the Higher Education Act, the University Regulations, the European Credit Transfer System (ECTS). Doctoral students from all regions of the Republic of Bulgaria and from abroad can study in the doctoral program "Inorganic Chemistry". The training in the doctoral program lasts three academic years for regular and independent form. The curriculum includes compulsory and elective subjects. The program for training doctoral students in Inorganic Chemistry aims to prepare highly qualified specialists with serious theoretical and practical training in the field of modern inorganic chemistry - synthesis and characterization of new materials, catalysis (including electrocatalysis) and others. The training is organized within 6 semesters and ends with the development and defense of a dissertation. This doctoral program provides opportunities for conducting scientific, research, teaching and management-organizational activities in the field of chemical sciences. The specialists who have successfully defended and acquired the ONS "Doctor" can be realized in research, production and educational organizations.

I. COMPETENCIES AND REQUIREMENTS

The graduate of the doctoral program "Inorganic Chemistry" must:
- to have systematic knowledge for performing critical chemical analysis and for generating and implementing new ideas in the field of inorganic chemistry;
- to demonstrate knowledge related to mastering research methods and their application in problem analysis.

- to have the potential of knowledge for conducting innovative research, analytical approach, correct interpretation, synthesis of summaries and priority derivation;
- to have knowledge with the highest degree of complexity and ability to expand them in the specialized field, competencies in related scientific fields and abilities to apply an interdisciplinary approach.
- to organize and plan his scientific activity, analytically and critically evaluate the experimental results, has skills to create and manage networks or teams, to manage human and financial resources;
- reasoned and substantiated with evidence to analyze and defend those related to the scientific field and the topic of the dissertation, seek innovative solutions by combining different strategies and models, improve, adapt and test new methods and approaches;
- to demonstrate competencies for interpretation, both of one's own research and of studied points of view, shows skills for expanding the scope of the studied scientific field.
- to use scientific language and style, characterized by accuracy of handling scientific terminology, clarity and logical consistency in presenting facts and results.

II. QUALIFICATION AND REALIZATION

Graduates of the doctoral program can be successfully realized as scientists in research institutions, experts in specialized laboratories, specialists in the system of the Ministry of Environment and Water, other ministries and agencies, in the system of state, regional and municipal administration, in enterprises and companies in the field of production such as chemists, experts in the field of inorganic chemistry and administrative managers, in consulting, design companies and non-governmental organizations developing basic and applied research projects, sales representatives in specialized companies for chemical equipment, chemical expertise, etc.

№	COURSES AND ACTIVITIES	Tuition and form of education			Certification Format
		CREDIT POINTS	TUITION HOURS	lectures, seminars, laboratory sessions, independent studies, consultations, contribution, etc.	examination, ongoing evaluation, interview, certificate,report, protocol, attestation, etc.
I.	**TUITION**				
1.	Compulsory course 1 (on the thematic focus of the dissertation)	9.0	270	30 c / 240 is	exam
2.	Compulsory course 2 (on the thematic focus of the dissertation)	9.0	270	30 c / 240 is	exam
3.	Project design and management	3.0	90	30 c / 60 is	exam
4.	English language	4.0	120	60 c / 60 is	exam
5.	Elective course	5.0	150	30 ce / 120 is	exam
	TOTAL:	**30**	**900**		
II.	**ACADEMIC RESEARCH**				
1.	Elaboration and presentation of a concept for the structure and content of the dissertation, determination of the goal, tasks and research methods.	3.0	90	Independent study Consultations	report
2.	Search and research of literary sources on the topic of the dissertation.	10.0	300	Independent study Consultations	report
3.	Analysis of selected literature sources and writing the chapter "Literary review - the state of the problem".	8.0	240	Independent study Consultations	report
4.	Performing experimental work on the given topic.	15.0	450	Independent study Consultations	report
5.	Preparation and writing of part of the dissertation: "Materials and methods used".	10.0	300	Independent study Consultations	report
6.	Systematization, processing and analysis of research data.	14.0	420	Independent study Consultations	report
7	Preparation and writing of a part of the dissertation: "Results and discussion".	20.0	600	Independent study Consultations	report
8	Preparation of a report and participation in a scientific forum.	12.0	360	Independent study Consultations Contribution	certificate
9	Preparation and publication of an article in a scientific journal on the thematic focus of the dissertation.	12.0	360	Independent study Consultations	publication (minimum two)
10	Final processing and finalization of the dissertation.	15.0	450	Independent study Consultations	report
11	Preparation, presentation and discussion of the dissertation work of the department council.	5.0	150	Independent study Consultations	report
12	Completion of the dissertation. Preparation for approbation.	6.0	180	Independent study Consultations	report
	Total :	**130**	**3900**		
III.	**Teaching**				
1.	Conducting laboratory exercises.	4.0	120	Independent study Consultations	protocol, report
2	Consultations of students from Bachelor's degree.	3.0	90	Independent study	report

3	Checking tests, presentations, written works, etc., prepared by students studying at the Department of Chemistry.	6.0	180	Independent study	report
4	Guide to research practice of students from the Bachelor's degree.	2.0	60	Independent study	protocol, doclad
	TOTAL :	**15**	**450**		
IV.	**MISCELANEOUS**				
1.	Participation in meetings of the Department of Chemistry.	1.0	30	participation	protocol
2.	Participation in university commissions.	1.0	30	participation	protocol
3.	Participation in the work of departmental commissions, working meetings or other administrative activities.	3.0	90	participation	protocol
	TOTAL :	**5**	**150**		
	GRAND TOTAL (*for the entire period of study*)**:**	**180**	**5400**		

V.	**MODULE B – ELECTIVE COURSES**				
1.	Catalysis and rate of chemical processes	5.0	150	30 c / 120 is	exam
2.	Validation of electrochemical methods	5.0	150	30 c / 120 is	exam
3.	Modern metrological aspects in chemistry	5.0	150	30 c / 120 is	exam
4.	Statistical methods in modern metrology	5.0	150	30 c / 120 is	exam
5.	Bioelectrochemical systems	5.0	150	30 c / 120 is	exam

* Note: The subjects "Foreign language" (English) and "Preparation and management of research projects" are included in the curriculum of all doctoral students at SWU "Neofit Rilski", as mandatory by decision of the Academic Council.

TRAINING COURSES
COMPULSORY COURSES

MODERN ELECTROCHEMICAL METHODS FOR CHARACTERIZATION AND ANALYSIS

Lecturer: Assoc. Prof. Elitsa Chorbadzhiyska, PhD

The training in the discipline includes the study of: Modern electrochemical methods for analysis; Potentiometry; Potentiometric determination of pH; ion-selective electrodes; Linear voltammetry; Cyclic voltammetry; Chronoamprometry; Impedance. The aim is for doctoral students to acquire basic knowledge related to modern electrochemical methods, as well as to acquire skills for their use and interpretation of the results. These are some of the main methods that are needed to perform the experimental work of the doctoral student. Doctoral students are expected to acquire knowledge, practical skills and experience in the field of modern electrochemical methods, allowing a wider profile.

METROLOGY IN ANALYTICAL CHEMISTRY
Lecturer: Assoc. Prof. Petko Mandjukov, PhD

Metrology, as a science of measurements, is the basis of all analytical procedures. To provide basic knowledge of national and international standards governing the work of analytical laboratories. Knowledge of the basic metrological principles is mandatory for specialists working in the field of analytical chemistry. The course provides basic and interdisciplinary training in the field of theoretical and legislative foundations of modern metrological measurements in chemistry. The aim is to train highly qualified specialists in the field of metrology and measuring chemical apparatus and equipment.

ELECTIVE COURSES
(* the doctoral student chooses one of the presented disciplines, which is included in the individual curriculum; * credits: 5)

CATALYSIS AND RATE OF CHEMICAL PROCESSES

Lecturer: Assist. Prof. Elitsa Chorbadzhiyska, PhD

The lecture material is divided into next sections: "Speed of chemical processes and kinetic equations", "Mechanism of chemical processes. Chemical processes in the presence of catalysts "," Homogeneous catalysis and heterogeneous catalysis "," Adsorption processes "and" Basic characteristics of catalysts ". Laboratory exercises are related to determining the speed constant, tracking the kinetics of a process, etc. The course presents: the factors influencing the speed of chemical processes; the main types of catalytic processes with their features, advantages and disadvantages; the formal kinetics of heterogeneous catalytic processes; methods for preparing catalysts; study of their properties and the influence of conditions on the kinetics of processes and the composition of catalysts. The course gives an idea of the opportunities that catalysts provide in the production of various products. The main tasks of these program are: Presentation of basic problems of kinetics and catalysis; Acquisition of practical knowledge, skills and abilities to work in a laboratory. Development of creative thinking and independent finding of appropriate solutions; Consideration of chemical processes in the presence of catalysts, types of catalysis and adsorption processes. The aim of the course is for doctoral students to acquire basic theoretical knowledge in the field of kinetics and catalysis through the use of modern teaching methods and tools and their active participation in the learning process. The expected results are related to the acquisition of knowledge, practical skills and experience in the field of kinetics and catalysis, allowing a broader implementation of the trainees.

VALIDATION OF ELECTROCHEMICAL METHODS

Lecturer: Assist. Prof. Elitsa Chorbadzhiyska, PhD

The course presents the basic concepts, subject, tasks and the need for validation of analytical methods. The analytical parameters for validation, the method of determination and calculation are described in detail, the development and validation of an analytical method is presented. The main tasks of the program are: Introducing students to the theoretical foundations, definitions used in the validation of an analytical method; Acquisition of practical knowledge, dexterity and skills for work in analytical laboratories, developing new analytical methods and performing validation; Development of creative thinking, selection of analytical parameters for validation according to the method used and its applicability. The purpose of the program is to provide specialized training

in terms of validation of analytical methods. The course introduces doctoral students to the basic concepts, analytical parameters and approaches to validation. Doctoral students are expected to acquire the basic theoretical knowledge and approaches required for validation. To acquire skills for developing and implementing a new analytical method. Basic knowledge of analytical chemistry, general chemistry, mathematics is required for the successful study of the study material.

MODERN METROLOGICAL ASPECTS IN CHEMISTRY

Lecturer: Assoc. Prof. Petko Mandjukov, PhD

The aim of the course is to acquaint doctoral students with the main factors guaranteeing the quality of analytical results. The main tasks are: Introducing students to the basic concepts in metrology and the structure of national, regional and international metrological institutions; Introducing students to the methods of estimating uncertainty and the statistical apparatus needed for these assessments; Acquisition of knowledge and skills for verification and validation of analytical methods; Skills for declaring and proving metrological traceability of analytical results. Doctoral students are expected to acquire knowledge of the principles of metrological traceability, calibration, assessment of the uncertainty of analytical results. To acquire practical knowledge, skills and competencies necessary for successful implementation in modern analytical laboratories and laboratories for metrological control. Successful study of the study material requires basic knowledge of physics, general and inorganic chemistry, analytical chemistry and mathematics.

STATISTICAL METHODS IN MODERN METROLOGY

Lecturer: Assoc. Prof. Dr. Petko Mandjukov

Statistics is a branch of mathematics that studies the production of information through the analysis and interpretation of empirical data using probability theory. Statistical activities also include planning and organizing data collection through surveys and experiments. The aim of the course is to acquaint doctoral students with statistical methods in modern metrology. Statistics arise in connection with the needs of empirical science and differ from most branches of mathematics in their applied orientation. Through the methods of statistics, the data can be analyzed, taking into account the randomness and uncertainty of the observations, and on this basis to draw conclusions about the regularities contained in them. Successful study of the study material requires basic knowledge of physics, general and inorganic chemistry, analytical chemistry and mathematics.

BIOELECTROCHEMICAL SYSTEMS

Lecturer: Assist. Prof. Elitsa Chorbadzhiyska, PhD

Bioelectrochemical systems combine biocatalyzed and electrocatalyzed processes. The lecture material covers topics related to electrocatalysis, biocatalysis, types of microbial fuel cells and electrolytic cells, as well as their applications. The consolidation of the learned material is done through practical work, project development, implementation of research problems. Topics related to the design and optimization of different types of bioelectrochemical systems are covered. The main tasks are: Acquisition of knowledge in Bioelectrochemical systems based on knowledge related to general chemistry, electrochemistry, microbiology and biochemistry; Acquisition of skills for performing interdisciplinary experiments in a specialized scientific laboratory in bioelectrochemistry; Development of interdisciplinary thinking and ability to work independently with specialized scientific literature. The purpose of the program