

**Non-profit JSC "Kazakh National Research Technical University" named after
K.I.Satpayev
Institute of information and telecommunication technologies
Department of Electronics, telecommunication and space technologies**

Educational programm CURRICULUMPROGRAM

«Telecommunication»

PhD

**In the field of modern telecommunication systems and innovate areas of the
development of intelligent digital communication systems, as well as in related
fields of applied tasks of digital information transmission**

Based on expired classifier of specialty: « 8D06201 – Telecommunication »

1st edition

In accordance with Education State Standards of higher school in 2019

5

Almaty 2020

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The program was created and signed by:

From KazNTU named after K. Satpayev:

1. Head of the Department of electronics, telecommunications and space technology (ETST).....I.Syrgabayev

2. Institute of industrial automation and digitalization named after A. Burkitbayev (IIAD).....B.O.Omarbekov, PhD

3. Chairman of the educational and methodological group of the Department.....N.K.Smailov, PhD

From employers-Director Of the Institute of space engineering and technology, doctor of technical SciencesD.Sh.Akhmedov

Approved at the meeting of the Educational and methodological Council Of the Kazakh national research technical University named after K. I. Satpayev. Protocol № from _____.____.2020.

Qualification:

Level 8 of the National qualifications framework (PhD)

8D06201-Telecommunications

8D062 Intelligent infocommunication technologies

Professional competence: telecommunications, information and communication technologies, intelligent technologies

PASPORT OF THE EDUCATIONAL PROGRAMM

1 Scope and content of the programm

The telecommunication program provides for the study of the following innovative disciplines:

- Computer-integrated technologies in telecommunications;
- Modeling and optimization in telecommunication systems and networks;
- Neural network technologies;
- Intelligent systems;
- Research planning and processing of experiment results;
- Administration in intelligent Info communications networks;
- High frequency transistor converters;
- Control drivers in transistor converters.

PhD should:

To know:

- about the level of development of technical means, scientific achievements, international scientific forums;
- about modern software for research and modeling and for design of complex radio-electronic devices and systems and intelligent networks;
- about the modern technical means applied for creation of multiservice and intelligent networks;
- about modern methods of building of building a high-frequency transistor converters, principles of operation of primary power supply electronic systems principles of operation of secondary power sources, electronic systems.
- about the modern technical means applied for construction of intellectual infocommunication technologies and neural technologies;

Be able to:

- to put tasks of research, to develop technical projects for the introduction of innovative information and communication equipment;
- collection and analysis of initial data for the design of communication facilities, intelligent infocommunication networks and their elements;
- be able to develop software software work tools focused on network technologies (mobile technologies);
- to formulate the main technical requirements for telecommunication networks and systems; to assess the main problems associated with the operation and implementation of new telecommunications equipment;

To know:

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- theoretical modern methodologies of scientific research, modern infocommunication technologies of acquisition, representation, processing and management of knowledge;
- methods of information transmission and distribution in telecommunication systems and networks;
- centralized data processing systems in infocommunication networks;
- the areas of technology, including a set of hardware and technology tools and methods aimed at ensuring uninterrupted, reliable and high-quality operation of infocommunication equipment in order to meet all the requirements of industry normative and technical documents; basic methods of building infocommunication networks for various purposes; wired and radio communication systems; basic methods of construction of data processing and storage systems; methods and methods of control and measurement of the main technical parameters of infocommunication equipment.

To have the skills:

- to have an understanding of the architectures of intelligent systems, including multi-agent architectures, neural networks. Know the principles of building intelligent systems, including expert systems, decision support systems;
- the ability to use regulatory and legal documentation specific to the field of infocommunication technologies and communication systems;
- on the organization of works on collection, storage and processing of the information applied in the sphere of professional activity.

PhD in Telecommunications should solve the following tasks in accordance with the types of professional activity:

in the field of production and technological activities:

- author's support of the processes of design, implementation and maintenance of intelligent infocommunication systems in production;

in the field of organizational and management activities:

- organization of interaction between the teams of the developer and the customer, management decisions in the conditions of different opinions;
- organization of work of small groups of performers;
- development of operational work plans of primary production units;
- preparation of technical documentation, as well as established reporting on approved forms;
- preparation of initial data for selection and justification of scientific, technical and organizational decisions made using economic criteria;
- ensuring the protection of intellectual property and research and development results as a trade secret of the enterprise;

in the field of experimental research:

- mathematical modeling of infocommunication processes and objects on the basis of both standard packages of computer-aided design and research, and independently created original programs;
- conducting experiments according to the given methodology, analyzing the results and making recommendations to improve the technical and economic indicators of infocommunication equipment;
- measurement and observation, description of research, preparation of data for reviews, reports and scientific publications.

in the field of research and teaching activities:

- collection, analysis of scientific and technical information, domestic and foreign experience on the subject of research;
- development and research of theoretical and experimental models of objects of professional activity in various fields;
- development and research of methods of analysis, synthesis, optimization and forecasting of quality of processes of functioning of objects;
- acceptance and development of the introduced innovative equipment;
- setting up and conducting experiments according to a given technique and analysis of the results;
- analysis of experimental results, preparation and compilation of reviews, reports and scientific publications;
- organization of measures for labor protection and safety in the process of commissioning, maintenance and repair of infocommunication equipment;
- forecasting of development of radio-electronic and telecommunication systems and technologies;

in the field of design and calculation-design activities:

- model development at the main stages of info communication networks and radio communication systems design;
- to apply real equipment for instrumental measurements used in the field of info communication technologies and communication systems;
- ability to carry out installation, adjustment, adjustment, experimental check of operability, tests and commissioning of constructions, means and the equipment of networks and the organizations of communication.

In the course of the training, there are industrial practices at such enterprises as Kazakhtelecom JSC, Kazakhtelecom subsidiaries, Kar-Tel LLP, Beeline, etc.

Scientific internships are also provided: Lublin technical University (Poland), St. Petersburg state technical University (Russia), Riga technical University (Latvia), University of nice Sofia-Antipolis, France, Xinjiang University (China), Penza state University (Russia, Penza), Novosibirsk state technical University

(Russia, Novosibirsk), Ariel Ariel University (Israel, Ariel), Humboldt University (Germany), Moscow technical University of communication and Informatics (Russia), Hokkaido University (Japan).

2 Requirements for applicants

Admission of students to OP Intelligent infocommunication technologies is carried out on the basis of clearly developed criteria, transparent and accessible to applicants, with a description of the learning environment, acquired competencies, as well as future employment opportunities. Admission to the University is carried out according to the statements of the entrant that completed the full course of scientific and pedagogical master's program in "Engineering of telecommunication systems" and "Intelligent info-communication systems" in accordance with points certificate issued on the test results at the national English test and an oral test on the subjects.

Special requirements for admission to the program are applied to graduates of the profile master's degree program "radio engineering, electronics and telecommunications", as well as master's degree in related educational programs: instrumentation, information systems, computer equipment and software, radio engineering, electronics and telecommunications, information security systems, electricity.

Credit transfer rules for related educational programs.

| Code | competence type | Description of competence | Result of competence | Responsible |
|------|--------------------------|--|--|------------------------------------|
| S1 | English | - readiness for further self-study in English in various fields - readiness to acquire experience in project and research work using the English language | Transfer of English credits from academic to professional level (up to 15 credits) | Department of English |
| S2 | Computer skills | - Basic programming skills in one modern language - use of software and applications for teaching various disciplines | Credit transfer by discipline Introduction to information and communication technologies, Information and communication technologies | Department of software engineering |
| P1 | Professional competences | - critical perception and deep understanding of | Credit transfer in basic professional disciplines, | Producing Department |

| | | | | |
|--|--|---|---|--|
| | | professional competencies at level 5 or 6 - the ability to discuss and debate on professional issues within the framework of the mastered program | modern management theory, methods of system analysis. | |
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The University may refuse to transfer credits if a low diagnostic level is confirmed or the final grades for completed disciplines were lower than A and B.

3 Requirements for completion and graduation

Mandatory standard requirements for the completion of doctoral studies and the assignment of a PhD degree: the development of at least 75 academic credits of theoretical training and preparation for the state exam in the specialty and thesis defense.

Special requirements for the completion of doctoral studies in this program *the graduate should know:*

- to know the methods of using modern software in the design of telecommunication systems and software development for information transmission in information management systems, skills in the development of structural, functional and schematic diagrams of information transmission systems.;

- to know legal bases of protection of computer information, mathematical bases of cryptography, organizational, technical and program methods of protection of information in modern computer systems and networks, and also to be able to apply known methods and means of support of information security in computer systems, to carry out the comparative analysis, to choose methods and means, to estimate level of protection of information resources in applied systems;

- to know methods of construction and analysis of mathematical models, methods of planning and optimization of experiments with models on a computer, construction and realization of elementary models on a computer; - to know theoretical bases, modern methods and means of the system analysis in telecommunication systems. Know the methods of electronic modeling. Be able to create and analyze electronic circuits. Know the theory of signal transmission, machine vision, transmission and compression of video images, two-dimensional and three-dimensional images of their description, image restoration. Image smoothing techniques, anti-aliasing formats, analysis and processing of color and multi-zone images.

- knowledge of modern fiber-optic transmission systems that combine all types of traffic to create info communication space; theoretical analysis of processes in the next generation communication networks, in particular, should form the ability to calculate such characteristics as the bandwidth of network elements, the quality of service applications, etc. - to know algorithms of construction of systems of digital communication, the regularities defining properties of devices of data transmission and tasks of their functioning. Modern trends and technologies of wireless radio communication, principles of construction of logical and physical structure of wireless networks of information transmission.

- ability to take into account modern trends in the development of electronics, measuring and computer technology. Be able to design and calculate the main characteristics and parameters of electronics. To gain skills of analysis and synthesis of electronic circuits of electronics and application of the received information for design. Ability to understand operation and maintenance of power supply systems of telecommunication equipment;

- ability to understand the issues of information transmission through space and ground radio communication systems, various methods of radio image recovery and processing in remote sensing of the earth, electromagnetic compatibility of space and ground systems. To know the principles of information transmission in wireless networks, the basics of information security at the network level, trends and prospects for the development of modern telecommunications and network technologies. Ability to understand the principles of operation and maintenance of power systems of space devices.

ability to do:

- to carry out the analysis, to form statements of problems, to develop mathematical models, to carry out modeling in intellectual info communication technologies of functioning of systems of modern software products; - to apply the known methods and means of support of information security in computer systems, to carry out the comparative analysis, to choose methods and means, to estimate level of protection of information resources in applied systems.; - to build the simplest electronic circuits on electronic devices and chips, to choose the element base for a specific field of application of devices; to calculate the elements of power supply systems; - to analyze discrete messages; to synthesize devices of reception and transmission of messages; to define the regularities defining properties of devices of data transmission and tasks of their functioning; to develop models of wireless networks and to apply analytical methods of research of quality of functioning of networks

To obtain a PhD, a graduate must prepare and defend a scientific thesis approved by the MES of Kazakhstan.

Working curriculum of the educational program

| Year of study | Code | Name of discipline | component | Credits- EcTS | lec/lab/pr | prerequisites | code | Name of discipline | component | credits EcTS | lec/lab/pr | prerequisites |
|---------------|-------------------|--|-----------|------------------|------------|---------------|----------------------|--|-----------|-----------------|------------|---------------|
| 1 | 1 semester | | | | | | 2 semester | | | | | |
| | MET321 | Research methods | BD IC | 3-6 | 0/0/3 | | AAP345 | Doctoral student research work, including internships and doctoral dissertations | DSR W | 8-24 | | |
| | LNC304 | Academic writing | BD IC | 3-6 | 2/0/1 | | | | | | | |
| | ELC314 | Digital image acquisition and processing. | BD OC | 3-6 | 2/0/1 | | AAP350 | Pedagogical practice | BD | 3-10 | | |
| | ELC3082 | Computer-integrated technologies in telecommunications | | | | | | | | | | |
| | ELC315 | Software Defined Radio | PS OC | 3-6 | 2/0/1 | | | | | | | |
| | ELC3102 | Heterogeneous multiservice networks NGN (Next Generation Network) | | | | | | | | | | |
| | ELC3032 | Mathematical and computer modeling in the RET | PS OC | 3-6 | 2/0/1 | | | | | | | |
| | ELC3132 | Administration in intelligent infocommunication networks | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | Total: | | 15-30 | | | Total: | | | 11-34 | | |
| 2 | 3 семестр | | | | | | 4 семестр | | | | | |
| | AAP345 | Doctoral student research work, including internships and doctoral dissertations | DSR W | 8-24 | | NI RD | AAP346 | Doctoral student research work, including internships and doctoral dissertations | DSR W | 8-25 | | |
| | AAP349 | Rsearch practice | PS | 3-10 | | | | | | | | |
| | | Барс: | | 11-34 | | | | Барс: | | 8-25 | | |
| 3 | 5 семестр | | | | | | 6 семестр | | | | | |
| | AAP346 | Doctoral student research work, including internships and doctoral dissertations | DSR W | 8-25 | | | AAP346 | Doctoral student research work, including internships and doctoral dissertations | DSR W | 8-25 | | |
| | | | | | | | ZD | Registration and defending of the PhD dissertation | ИА | 4-12 | | |
| | | Total: | | 8-25 | | | | Total: | | 12-37 | | |
| | | | | | | | Total credits | | 65 | | | |

MODULAR CURRICULUM

Education program « 8D06201 – Telecommunication »

Form of education: Full-time Duration: 3 years Academic degree: Doctor of philosophy PhD

| The cycle | code | Name of disciplines | Semester | Acad. credits | lec. | lab. | prac | IWS | Type of control | Chair |
|---|---------|--|-------------------------------------|---------------|------|-------------------------|------|-----|-------------------|-------|
| Profile training module (45 credits) | | | | | | | | | | |
| Basic disciplines (BD) (18) | | | | | | | | | | |
| University component (12) | | | | | | | | | | |
| BD 1.1.1 | LNG304 | Academic writing | 1 | 6 | 2 | 0 | 1 | 3 | Exam | |
| BD 1.2.2 | MET321 | Research methods | 1 | 6 | 2 | 0 | 1 | 3 | Exam | |
| Choice component (6) | | | | | | | | | | |
| BD 1.3.1 | ELC314 | Digital image acquisition and processing. | 1 | 6 | 2 | 0 | 1 | 3 | Exam | |
| BD 1.3.2 | ELC3082 | Computer-integrated technologies in telecommunications | 1 | 6 | 2 | 0 | 1 | 3 | Exam | |
| Practice-oriented module (10) | | | | | | | | | | |
| BD 1.4.1 | AAP350 | Pedagogical practice | 2 | 10 | | | | | Report | |
| Major disciplines (MD) (12) | | | | | | | | | | |
| Choice component (12) | | | | | | | | | | |
| MD 1.5.1 | ELC315 | Software Defined Radio | 1 | 6 | 2 | 0 | 1 | 3 | | |
| MD 1.5.2 | ELC3032 | Mathematical and computer modeling in the RET | 1 | 6 | 2 | 0 | 1 | 3 | | |
| MD 1.6.1 | ELC3102 | Heterogeneous multiservice networks NGN (Next Generation Network) | 1 | 6 | 2 | 0 | 1 | 3 | Exam | |
| MD 1.6.2 | ELC3132 | Administration in intelligent infocommunication networks | 1 | 6 | 2 | 0 | 1 | 3 | Exam | |
| Practice-oriented module (10) | | | | | | | | | | |
| MD 1.7.1 | AAP349 | Research scientific training | 3 | 10 | | | | | Report | |
| Research Module (123) | | | | | | | | | | |
| DSRW | AAP345 | Doctoral student research work, including internships and doctoral dissertations | 2 | 24 | | | | | Report | |
| DSRW | AAP345 | Doctoral student research work, including internships | 3 | 24 | | | | | Report | |
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| | | and doctoral dissertations | | | | | | | | |
| DSRW | AAP346 | Doctoral student research work, including internships and doctoral dissertations | 4 | 25 | | | | | Report | |
| DSRW | AAP346 | Doctoral student research work, including internships and doctoral dissertations | 5 | 25 | | | | | Report | |
| DSRW | AAP346 | Doctoral student research work, including internships and doctoral dissertations | 6 | 25 | | | | | Report | |
| Final attestation module | | | | | | | | | | |
| FA | ECA303 | Writing and defending doctoral dissertation | 6 | 12 | | | | | | |
| | | Total | | 185 | | | | | | |

5 Descriptors of the level and scope of knowledge, skills, skills and competencies

A-knowledge and understanding:

A1-the Ability to independently conduct theoretical analysis of processes in the next generation communication networks, in particular, the ability to calculate such characteristics as the bandwidth of network elements, the quality of service applications, etc. should be formed.;

A2-Has the knowledge and skills to solve problems in the field of telecommunications, electronics and radio engineering can also find solutions to technical problems;

A3-Ability to understand the principles of construction and operation of switching systems and creation on their basis of new infocommunication technologies and services at convergence of communication networks and transition to multiservice networks, methods of design and maintenance of switching systems..

B-application of knowledge and understanding:

B1-for independent development and preparation of proposals for various options for solving professional problems using theoretical and practical knowledge

B2 - application of methods of mathematical and simulation modeling of the studied processes;

B3 - application of experimental planning and statistical data processing methods.

C - formation of judgments:

C1 - about computer-integrated technologies for the work of a modern enterprise;

C2-on modern approaches in telecommunication technologies for creation of multiservice and intelligent networks;

C3-on the development of artificial neural networks to create different approaches to information processing

C4 - about modern technical support of radio engineering and telecommunications systems, allowing to create optimal variants of communication networks and corresponding electronic equipment.

D-personal abilities:

D1-to be a researcher in a scientific or innovation organization for the development, design and implementation of intelligent infocommunication technology or telecommunications;

D2 - to be a teacher of special disciplines in a University or College;

D3 - to be a competent methodologist for the development of teaching materials for students in the field of radio engineering, electronics and telecommunications;

D4 - to be able to organize fruitful study of students as an adviser.

6 Competences on completion of training

Б -basic knowledge and skills:

Б 1-capable of philosophical analysis of social phenomena, personal behavior and other phenomena. Ready to conduct a philosophical assessment of social phenomena;

Б 2-to know and apply in practice the basics of pedagogical ethics;

Б 3-to be able to analyze actual problems of modern history of Kazakhstan.

П -professional competence:

П 1-a wide range of theoretical and practical knowledge in the professional field;

П2-is able to analyze scientific articles, monographs and technical documentation for the development of intelligent infocommunication technologies and processes.

П 3-ready to set and solve scientific problems, develop, implement, install, adjust and operate communication systems or telecommunications;

О-universal, social and ethical competences:

О1-is able to use English fluently as a means of business communication, a source of new knowledge in the field of intelligent infocommunication technology or telecommunications. Ready to use English in professional activities in the field of intelligent infocommunication technology or telecommunications;

О2-is able to speak Kazakh (Russian) language fluently as a means of business communication, a source of new knowledge in the field of intellectual infocommunication technologies or telecommunications. Ready to use Kazakh (Russian) language in professional activities in the field of telecommunications;

О3-to know and apply in work and life the basics of applied ethics and ethics of business communication;

О4-to know and apply the basic concepts of professional ethics;

О5-to know and solve the problems of human impact on the environment.

С-special and managerial competencies:

С1-independent management and control over the processes of labor and educational activities within the framework of the strategy, policy and goals of the organization, discussion of the problem, reasoning of conclusions and competent handling of information;

С2-to be a specialist in theoretical and experimental studies of objects in electronics, telecommunications;

С3-the ability to demonstrate a set of skills to manage the work process, the ability to choose methods, methodologies and evaluation criteria to obtain results, allocate and delegate authority, form teams, and make decisions during the production process.

C3-to be a teacher of the University and be able to convey to students the knowledge and skills in the development, design, installation and operation of telecommunication systems.

7 Description of disciplines

Research methods

Code – MET321

Credit – 3 (0/0/3)

Prerequisite –

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of mastering the discipline "Methods of scientific research" is to provide doctoral students with theoretical and applied knowledge on methods of scientific research of problems in the field of telecommunications, training specialists with cognitive skills in the field of science, forming deep ideas about the content of scientific activity, its methods and forms of knowledge.

BRIEF DESCRIPTION OF THE COURSE

Methods of scientific research are among the disciplines of the variable part. This discipline is a Central part of professional training, and the course is interdisciplinary in nature. It is logically based on the knowledge gained during the study of such courses as philosophy, culturology, psychology, geography, and concepts of modern natural science. Knowledge of this discipline is necessary for further study of professional disciplines, such as design, organization of scientific activities, passing industrial and pre-graduate practices, preparation of final qualification work.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

must know:

- conceptual and terminological apparatus,
- theoretical and empirical foundations of science,
- theoretical foundations of methodology,
- key functions of modern science,
- structural elements of theory,
- stages of scientific research;

must be able to:

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- update the issue,
 - determine the purpose, objectives, object and subject of research,
 - formulate a hypothesis,
 - implement the main stages of the research topic and perform reports on scientific work in accordance with modern requirements;
- must own:
- basic rules, principles and regularities of scientific, research and methodological activities,
 - fundamentals of the scientific worldview,
 - skills in determining the research methodology, organizing independent research of the project,
 - practice of efficient use of resources and scientific organization of work.

Academic writing

Code – LNC 304

Credit – 3 (2/0/1)

Prerequisite –

PURPOSE AND OBJECTIVES OF THE COURSE

The goal of the course "Academic writing" is the formation of professional competence and expansion of communicative competence related to analytical textual activities;

formation of linguistic and pragmatic thinking skills in doctoral students, the ability to analyze expressive units of the language and correctly select the desired unit depending on the goals and conditions of communication.

BRIEF DESCRIPTION OF THE COURSE

As a result of mastering the discipline, students should develop the following professional competencies:

- has a method of text analysis that contributes to the accurate perception of the original utterance;
- knows how to work with text, including searching for information in reference, special literature, and computer networks.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

In the course of training, doctoral students should have an idea of the actual object of study, the interaction of objects when creating their models.

know:

- goals and objectives of analytical text processing in the modern information space;
- genre and stylistic characteristics of the abstract, abstract, analytical review, scientific report;
- principles of the communicative organization of the abstract and abstract;
- rules for writing reviews;

be able to:

- conduct stylistic analysis of scientific, technical and popular science texts,
- determine the stylistic and genre affiliation of the text in the field of professional information;
- highlight style-forming elements of texts,
- perform semantic analysis of the text and highlight its keywords
- ;
- determine the means of speech expression;
- transmit the content of texts in the form of annotations, abstracts, reviews;

own:

- techniques for semantic text analysis;
- the method of communicative text analysis;
- annotation and abstract genres.- skills in applying the main methods of obtaining knowledge in the field of computer technology using modern information technologies.

Digital image acquisition and processing

CODE - ELC314

CREDIT - 3 (2/0/1)

PREREQUISITS:

1. Digital signal processing.
2. Modern sensor technologies and applications

THE AIM AND OBJECTIVES OF THE COURSE

The aim of teaching the course **“Digital image acquisition and processing”** is to introduce highly sophisticated CMOS image sensors and discuss advanced Image Processing and Computer Vision algorithms.

The objectives of the course:

- To explain the performance of the image sensor and the camera system.
- To provide deep knowledge about image sensor fabrication technology and the advanced image processing operations.

SHORT DESCRIPTION OF THE COURSE

“Digital image acquisition and processing” is an advanced course focusing on the solid-state image sensor technology and covers the major application classes of Image Sensors. It discusses high-quality optics that meet the requirements of better image sensors, the basic functions and performance parameters of image sensors, and detailed discussions of both CCD and CMOS image sensors. As well as the course explains how color theory affects the uses of Image Sensors, presents basic image processing and camera control algorithms and examples of advanced image processing algorithms, explores the architecture and required performance of signal processing engines, and explains how to evaluate image quality.

KNOWLEDGE, ABILITY, SKILLS UPON COMPLETION THE COURSE

Upon completion of the course, a master student is able to perform basic and advanced image processing algorithms, detect and classify objects in a digital image. **The course gives great opportunities for doctoral students to understand CMOS pixels and CMOS imager systems and new technologies of Digital Imaging systems.**

Software Defined Radio

CODE - ELC315

CREDIT - 3 (2/0/1)

PREREQUISITS:

1. Fundamentals of software-defined radio.
2. Digital signal processing

THE AIM AND OBJECTIVES OF THE COURSE

The aim of the course "**Software Defined Radio**" is to study the Software Radio Communication systems in detail.

The objectives of the course are:

- to provide the ability of designing different communication systems and knowing digital signal processing methods to create a software radio communication system.
- to provide deep knowledge about the principles of digital signal processing and radio communication platforms.

SHORT DESCRIPTION OF THE COURSE

The course "**Software defined radio**" contains training materials about different communication systems and digital signal processing to create a software communication system taught to PhD students of Electrical engineering, Radio Engineering, Electronics and Telecommunications, and Computer Science. The course provides a deep knowledge about Radio Frequency (RF) architectures, RF spectrum viewing methods and digital communication theory and simulation. The course content covers SDR platforms for Wireless communications to create an advanced software defined radio communication system.

KNOWLEDGE, ABILITY, SKILLS UPON COMPLETION THE COURSE

Upon completion of the course, PhD students can create advanced communication technologies based on SDR and implement various complex communication systems. The result of the course is the development of deep programming skills for creating different projects based on SDR.

Mathematical and computer modeling in the RET

Code – ELC3032

Credit – 3 (2/0/1)

Prerequisite – Digital devices and microprocessors; Digital signal processing

PURPOSE AND OBJECTIVES OF THE COURSE

The aim of the course is to master theoretical methods of optimization in telecommunication systems and networks and computer modeling of devices, technical means and systems in the field of RET. Getting knowledge and skills in converting mathematical models of various applied problems to a form that is convenient for calculating their solutions using computers.

Objectives: to provide knowledge of the basic terms and definitions, types, and principles of construction of mathematical and computer models of RET.

BRIEF DESCRIPTION OF THE COURSE

The course covers the following main sections of intelligent systems:

- Methods and role of mathematical and computer modeling in the process of cognition and design.
- Modeling of oscillating processes.
- Modeling of electric fields.
- Modeling of elements and components of electronic circuits of power electronics.
- Modeling of integrated circuits.
- Modeling of printed circuit boards.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

In the course of training, doctoral students should have an idea of the actual object of study, the interaction of objects when creating their models.

Know: know mathematical methods and software and technical tools of electronic modeling.

Possess: skills in creating and analyzing mathematical and computer models of electronic circuits and systems in the RET.

The educational program of doctoral studies includes:

- research practice - for students on the program of doctor of philosophy (PhD);

- industrial practice - for students on the program of profile doctoral studies.

Practice doctoral research is to study the latest theoretical, methodological and

technological advances domestic and foreign science and consolidate practical skills of application of modern methods of scientific research, processing and interpretation of experimental data in this thesis. The doctoral student's practical training is carried out in order to consolidate the theoretical knowledge gained in the course of training and improve the professional level.

The research work of the doctoral student needs:

- to correspond to the main problems of the specialty on which the doctoral dissertation is defended; to be actual, to contain scientific novelty and practical significance;
- to be based on modern theoretical, methodological and technological achievements of science and practice;
- to be based on modern methods of data processing and interpretation with the use of computer technologies;
- be carried out using modern methods of scientific research;
- contain research (methodological, practical) sections on the main protected provisions.

Experimental research work of a doctoral student should:

- to correspond to the main problems of the specialty on which the doctoral dissertation is defended;
- to be actual, to contain scientific novelty and practical significance;
- to be based on modern achievements of science, technology and production and to contain concrete practical recommendations, independent decisions of management tasks of complex, cross-functional character;
- be carried out with the use of advanced information technologies;
- contain experimental research (methodological, practical) sections on the main protected provisions.

Defense of doctoral dissertation (DD).

Code –ZD

| | | | |
|--------------|--|-------------------------|-------------------|
| Разработано: | Рассмотрено: заседание УС Института | Утверждено: УМС КазНУТУ | Страница 21 из 30 |
|--------------|--|-------------------------|-------------------|

Credir – 4

Prerequisite – No

PURPOSE AND OBJECTIVES OF PREPARATION AND DEFENSE OF DISSERTATION

A dissertation is a qualifying scientific work on a specific specialty of the educational program for the preparation of a doctor of philosophy (PhD).

The topic of the dissertation should be related to the priority directions of development of science and / or state programs, or programs of fundamental or applied research.

The content of the dissertation, the goals and objectives, the obtained scientific results should strictly correspond to the theme of the dissertation.

The dissertation is performed in compliance with the principles of independence, internal unity, scientific novelty, reliability and practical value.

The purpose of preparation and defense of the thesis is to master the skills of doctoral independent research and competent presentation of research results.

The tasks of preparation and defense of the thesis are: setting the goal of research, theoretical and experimental research of the object, development of control algorithms and synthesis of the control system.

SUMMARY OF THE THESIS

The main part of the dissertation should contain:

- selection of areas of study, including justification of research problem-solving methods and their comparative assessment, the description of the General methodology of scientific-research work;

- setting the purpose, object and subject of research, research objectives;

- the process of theoretical and (or) experimental research, including the definition of the nature and content of theoretical research, research methods, methods of calculation, justification of the need for experimental work, the principles of the developed objects, their characteristics;

- generalization and evaluation of research results, including the assessment of the completeness of the solution of the problem and proposals for further areas of work, assessment of the reliability of the results and their comparison with similar results of domestic and foreign works.

Each section of the dissertation should end with the main conclusions and be the basis for the next section. The presentation in the main part of the thesis should be strictly justified, holistic and logical. Spelling, grammar and punctuation errors in the dissertation should not be allowed. The style of presentation of the thesis text should be correct from a scientific point of view. No one's emotional

judgments and statements, expressions from fiction, everyday everyday expressions, jargon, etc. are allowed.

ACQUIRED KNOWLEDGE, SKILLS AND ABILITIES

The dissertation is written independently, contains a set of new scientific results and provisions put forward by the author for public protection and testifies to the personal contribution of the author to science. The new solutions proposed by the author should be reasoned and evaluated in comparison with the known solutions.

The thesis, which has applied value, provides information on the practical use of the scientific results obtained by the author, confirmed by the author's certificates, patents and other official documents, and the thesis, which has theoretical value-recommendations for the use of scientific findings.

The main content of the thesis is published in scientific, scientific-analytical and scientific-practical publications.

The main scientific results of the dissertation for the degree of doctor of philosophy (PhD) are published in at least 7 (seven) publications on the topic of the dissertation, including at least 3 (three) in scientific publications recommended by the authorized body, 1 (one) in an international scientific publication that has according to the information base of Thomson Reuters (ISI Web of Knowledge, Thomson Reuters) a non-zero impact factor or included in the database of Scopus, 3 (three) in the proceedings of international conferences, including 1 (1) in the materials of foreign conferences.

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РЕЦЕНЗИЯ

на образовательную программу высшего образования по направлению
«Интеллектуальные инфокоммуникационные технологии (ИИКТ)»
 для подготовки докторантов в области радиотехники,
 электроники и телекоммуникаций, разработанную кафедрой
«Электроника, телекоммуникации и космические технологии»
 Казахского национального исследовательского технического
 университета имени К.И. Сатпаева

В представленной образовательной программе (ОП) по направлению «Интеллектуальные инфокоммуникационные технологии» определен перечень всех учебных дисциплин, трудоемкость каждой учебной дисциплины в кредитах, последовательность их изучения, виды учебных занятий и формы контроля.

Программа составлена согласно общеобязательным типовым требованиям ГОСО РК для окончания вуза и присвоения доктор PhD: освоение не менее 110 академических кредитов теоретического обучения и прохождение обучающимся педагогической, исследовательской практик, написание диссертационной работы, сдачу комплексного экзамена и защиту диссертации..

Включенные в учебный план профессиональные дисциплины раскрывают сущность актуальных на сегодняшний день проблем в области радиотехники, электроники и телекоммуникаций, а также ориентированы на будущее. Для закрепления теоретических знаний в ОП «Интеллектуальные инфокоммуникационные технологии» предусмотрены следующие инновационные дисциплины: компьютерно-интегрированные технологии в телекоммуникация; моделирование и оптимизация в системах и сетях электросвязи; нейросетевые технологии; интеллектуальные системы; планирование научных исследований и обработка результатов экспериментов; администрирование в интеллектуальных инфокоммуникационных сетях; высокочастотные транзисторные преобразователи; драйверы управления в транзисторных преобразователях.

Разработанная образовательная программа по направлению «Интеллектуальные инфокоммуникационные технологии» включает 8 модулей, 3 из которых предусматривают

Вопросы, посвященные современным технологиям оптоволоконных систем передачи, объединяющих все виды трафика для создания инфокоммуникационного пространства, особенностям работы узлов сетей связи следующего поколения NGN (протоколы, вопросы качества обслуживания) рассмотрены в дисциплинах.

Считаю, что дисциплины посвящены рассмотрению актуальных вопросов, т.к. охватывают комплекс вопросов по использованию современных программных средств при проектировании телекоммуникационных систем и разработке программного обеспечения для

передачи информации в информационно-управляющих системах, правовые аспекты защиты компьютерной информации, математические основы криптографии, методы и средства защиты информационных ресурсов в прикладных системах.

Данный рабочий учебный план актуален, учитывает все требования работодателей при формировании дисциплин профессионального цикла, практикоориентирован.

Итак, представленная на рецензию образовательная программа может быть рекомендована для организации учебного процесса по специальности докторантуры «Радиотехника, электроника и телекоммуникации», освоение дисциплин предложенных модулей позволяет осуществить подготовку специалистов высшей научной квалификации для научной, научно-педагогической, производственной и инновационной сфер деятельности в области инфокоммуникаций.

От работодателей – Директор Института системной техники и технологий,
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