

№	Field name	Detailed content, comments
1.	Name of the faculty	Information radio technologies and technical protection of information
2.	Level of higher education	Doctor of Philosophy
3.	Code and name of specialty	172 Telecommunications and radio engineering
4.	Type and name of educational program	Educational and scientific program
5.	Code and name of the discipline	Methods of research, design and optimization of radio electronic systems. BB 1.4
6.	Number of ECTS credits	4
7.	Structure of the discipline	Lectures - 30, practical - 20,, consultations -8, independent work - 64, semester control - credit
8.	Schedule of study of the discipline	Course -1, semester - 1
9.	Prerequisites for the study disciplines	Previously, the following disciplines should be studied: higher mathematics, computer engineering and programming, signals and processes, metrology, design of devices on microcontrollers and FPGA, basics of digital technology, basics of computer modelling and design of TCRT, radioelectronic systems.
10.	Discipline abstract	<p>Module 1.</p> <p>Topic 1. Multifunctional measuring electronic systems and complexes.</p> <p>Topic 2. The process of creating new systems and the place of design in it.</p> <p>Topic 3. Methods of analysis, synthesis and design of radio networks.</p> <p>Topic 4. Mathematical methods of synthesis and analysis of radio networks.</p> <p>Topic 5. Optimization of radio networks on a set of quality indicators.</p> <p>Topic 6. Types of system quality criteria.</p> <p>Topic 7. The worst and worst systems. Exchange charts.</p> <p>Module 2.</p> <p>Topic 1. Unintentional electromagnetic interference.</p> <p>Topic 2. Technical imperfection of radio transmitters.</p> <p>Topic 3. Requirements for methodological and metrological testing of transmitting devices.</p> <p>Topic 4. Technical imperfection of radios.</p> <p>Topic 5. Features of antennas in terms of</p>

		<p>electromagnetic compatibility.</p> <p>Topic 6. Methodology for providing EMC conditions for wireless radio access systems.</p> <p>Practical training.</p> <ol style="list-style-type: none"> 1. Research of electronic systems by methods of mathematical and computer modelling. 2. Research of algorithms of signal processing by a method of computer modelling. 3. Unintentional interference. 4. Technical imperfection of radio transmitters. 5. Technical imperfection of radio receiving devices. 6. Calculation of the territorial distribution required for EMC. <p>Individual work.</p> <ol style="list-style-type: none"> 1. Features of phase direction finding in the joint signal processing of different antennas. 2. Direction finding using antenna arrays. 3. Monopulse amplitude sum-difference system. 4. Monopulse phase total-difference system. 5. Research detectors of coherent and incoherent pulse bundles by simulation. 6. Bodies of uncertainty of complex signals. 7. Spatial-temporal signal processing. 8. General characteristics and classification of unintentional EMF. 9. Methods and equipment for measuring the parameters of unintentional EMF. 10. General characteristics of radio transmitter radiation. 11. General characteristics of the channels of reception of EMC radios. 12. The main characteristics of antennas that affect the EMC. 13. Methods for estimating EMC of radio communication networks. Methods and ways of providing.
11.	Competences, knowledge, skills, understanding, which will be acquired by the applicant of higher education in the learning process	<p>Professional competencies:</p> <p>Ability to search, systematically study and analyze scientific and technical information, world experience related to the use of telecommunications and radio engineering to study various processes, phenomena and systems.</p>
12.	Learning outcomes of higher education seekers	<p>Program learning outcomes:</p> <p>Acquisition of knowledge and understanding of basic methods of data analysis and ability to apply tools and models of data analysis (hardware and software resources, application packages, online resources and related technologies) in the study of real systems and</p>

		<p>presentation of research results in various forms; implementation of scientific and pedagogical activities using these resources and technologies.</p> <p>The graduate student will know the principles of construction and methods of research, design and optimization of radar, radio navigation and radio control of moving objects; algorithms for optimal detection of signals and evaluation of their parameters; means of realization of algorithms in real systems, methods of protection of electronic systems from active and passive interferences, principles of calculation of FIR and BIH filters, software realization of digital filtering in real time with use of microprocessors.</p>
13.	Grading system according to each task for passing the test / exam	To evaluate the work of the graduate student during the semester, the final rating is calculated as the sum of grades for different types of classes and control measures.
14.	Quality of the educational process	<p>The quality of the educational process is based on:</p> <ul style="list-style-type: none"> - policy of academic integrity; - updating the content of the discipline on the basis of the results of modern scientific research and achievements in the field of methodology and methodology of obtaining new knowledge, organization of scientific research in telecommunications and radio engineering; - modern practical experience, modern techniques and technologies of information processing, theory and practice of metrology and implementation of experimental research, recommendations of employers. <p>Enrollment of missed classes is carried out when the graduate student performs all the tasks of his option.</p>
15.	Methodological support	1. Complex of educational and methodical support of educational discipline "Methods of research, design and optimization of radio electronic systems" of preparation of the doctor of philosophy of a specialty 172 "Telecommunications and radio engineering"

		<p>[Electronic resource] / KhNURE; developed. V.M. Kartashov. - Kharkiv, 2020. - 490 p. http://catalogue.nure.ua/knmz.</p> <p>2. Sitnik OV, Kartashov VM Radio engineering systems. –Kharkiv: SMITH, 2009.-448 p.</p> <p>3. Kartashov VM Models and methods of signal processing of systems of radioacoustic and acoustic sounding of the atmosphere. -Kharkiv: KhNURE, 2011. - 234 p.</p> <p>4. Methodical instructions on independent work in the discipline "Methods of research, design and optimization of electronic systems" for graduate students of all forms of education in the specialty 172 "Telecommunications and Radio Engineering" [Electronic edition] / Uporyad. V.M. Kartashov. - Kharkiv: KNURE, 2020. - 35 p.</p> <p>5. Methodical instructions for practical classes in the discipline "Methods of research, design and optimization of electronic systems" for graduate students of all forms of education in the specialty172 "Telecommunications and radio engineering" [Electronic edition] / Edited by: IV Savchenko, VM Oliynikov, VM Kartashov. - Kharkiv: KhNURE, 2020. -44 p.</p>
16.	Syllabus developer	Head Department of MEIRES, Professor Kartashov Vladimir Mikhailovich. volodymyr.kartashov@nure.ua