№	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 ВБ 1.4
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 radioelectronic systems
6.	Number of ECTS credits	4
7.	Structure of the discipline	Lectures - 30, practical - 20,, consultations -6, independent work - 64, semester control - credit
8.	Schedule of study of the discipline	Course -1, semester - 2
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 modeling and design of TCRT, radioelectronic systems.
10.	Discipline abstract	Content module 3. Topic 1. Review of modern stm32 processors. Topic 2 CPU clock system. Creating a new project. Topic 3 Programming timers-counters. Topic 4 Analog-to-digital and digital-to-analog converters. Topic 5. Implementation of digital signal processing using microcontrollers. Content module 4. Topic 1. Formats of decomposition of TV images. Topic 2. Formation of digital video signals. Topic 3. In-frame compression of video images. Topic 4. Interframe compression of video images. Topic 5. Compression of audio information. Topic 6. ATSC television broadcasting standard. Topic 7. DVB-T TV broadcasting standard: general concept, data encoding. Topic 8. Modulation in the DVB-T standard. Content module 4. Topic 1. Formats of decomposition of TV

		images.
		Topic 2. Formation of digital video signals.
		Topic 3. In-frame compression of video images.
		Topic 4. Interframe compression of video images.
		Topic 5. Compression of audio information.
		Topic 6. ATSC television broadcasting standard.
		Topic 7. DVB-T TV broadcasting standard: general concept, data encoding.
		Topic 8. Modulation in the DVB-T standard.
		Content module 5.
		Topic 1. Signal processing in Matlab using the functions of the Signal Processing Toolbox.
		Topic 2. Modeling of electronic systems in Matlab using the functions of the Communications Toolbox.
		Practical training.
		1. Setting the clock system and programming I / O ports.
		2. Programming of timers-counters.
		3. Programming of built-in DACs and ADCs.
		4. Digital signal processing.
		5. Research of sampling and quantization of images.
		6. Interframe coding of digital TV signal.
		7. In-frame coding of digital TV signal.
		8. Research of video codecs.
		9. Modeling of the data transmission system on the communication channel with intersymbol interference.
		10. Formation of signal-code constructions with lattice modulation.
		Individual work.
		1. General characteristics of processors of the F4, F7, H7 series.
		2. Formation of digital and analog signals, PWM, capture.
		3. Processing of sensor readings, implementation of FFT.
		4. Formats of decomposition of TV images.
		5. Formation of digital video signals.
		6. In-frame compression of video images.
		7. Interframe compression of video images.
		8. Compression of sound information.
		9. ATSC television broadcasting standard.
		10. DVB-T TV broadcasting standard.
		11. Modulation in the DVB-T standard.
		12. Data transmission systems on communication channels with intersymbol interference.
		13. Signal-code constructions with lattice

		modulation.
11.	Competences, knowledge, skills, understanding, which will be acquired by the applicant of higher education in the learning process	**Professional competencies:** 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.
12.	Learning outcomes of higher education seekers	**Program learning outcomes:** 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 presentation of research results in various forms; implementation of scientific and pedagogical activities using these resources and technologies. The graduate student will be able to: according to tactical and technical characteristics choose the principles of construction and structure of the system, formulate requirements for technical parameters of devices that make up the system, justify the effectiveness of selected technical solutions, perform analytical synthesis of structure and computer research of integrated electronic information systems. and digital information processing in electronic systems using modern processors.
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	The quality of the educational process is based on: - 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. Enrollment of missed classes is carried out when the graduate student performs all the tasks of his option.
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" [Electronic resource] / KhNURE; developed. V.M. Kartashov. - Kharkiv, 2020. - 490 p. http://catalogue.nure.ua/knmz. 2. Sitnik OV, Kartashov VM Radio engineering systems. –Kharkiv: SMITH, 2009.-448 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. 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, 2018. - 35 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, 2018. -44 p.
16.	Syllabus developer	Head Department of MEIRES, Professor Kartashov Vladimir Mikhailovich. volodymyr.kartashov@nure.ua