

## Content

### 1. Goals and objectives of the entrance exam according to the specialty.

The purpose of the entrance exam is to determine the level of theoretical training entering the doctoral program, and the formation of individual proposals for admission based on competitive participation.

The entrance exam includes subjects of mandatory components of the standard curriculum for the educational program "8D07115 - Electronics and Control Systems".

Applicants before the entrance exam of doctoral program must show the depth of the knowledge and potential to successfully present their diploma.

Applicants must demonstrate their ability to work independently with modern literature and show their achievements in the form of author's publications, diplomas, certificates in the field of modern radio engineering, electronics and telecommunications.

The entrance exam form is a combined written exam. Examinees transfer their answers to the questions of the exam tickets in the answer sheets. In case of a complaint, written answers to the answer sheet are the basis for consideration.

### 2. Requirements for the level of training of applicants to the PhD program

The minimum level of knowledge of those who want to master doctoral programs in the educational program "8D07115-electronics and control systems" - doctorate degree.

Requirements for applicants:

*be able to:* critically analyze and evaluate modern scientific achievements, form new ideas in solving research and practical problems.

*must know:* principles of building devices for automated control systems, their functions and characteristics of structural units, characteristics of analog, digital devices and electronic sensors.

*be able to:* analyze, systematize and synthesize scientific and technical information on the research topic

### 3. Prerequisites of the educational program

1. Circuit design of electronic systems

2. Modern systems of information transmission

### 4. List of exam topics

#### 1. "Circuit design of electronic systems"

1. The Principle of operation of the p-n-junction, its volt-ampere characteristics and parameters. Semiconductor diode. Principles of operation and production technology of semiconductor diodes. Radio frequency diodes, pulse diodes and shock diodes: device, operation, volt-ampere characteristics, parameters, marking, application. Metal-semiconductor junction. The varactors and Zener diodes.
2. The bipolar transistors. Graphical symbols. The device of the transistor. The concept of a forward and reverse conduction transistor. Operation of the transistor. Static characteristics of transistors: the concept of volt-ampere characteristics transistors. The concept of the transient response of the transistor.
3. Field-effect transistors with a "p-n" transition: its concept, operating principle, connection diagrams and characteristics. Fields with isolated gates: its concept, operating principle, connection diagrams and characteristic parameters.

4. Indicators and characteristics of amplifiers. Classification of amplifiers. The main quantitative indicators of amplifiers. Qualitative characteristics of the amplifiers. Linear and nonlinear distortion. Ways to charge bipolar transistors. The established stable basis. Calculation of the constant voltage on the base.
5. Feedback (FB) and its impact on device characteristics. Definition, principles, purpose, and types of feedback. Block diagram of the amplifier with FB. Classification of FB. Gain stages with a negative FB.
6. Amplifiers. Types of amplifiers: single-pole and double-pole power amplifiers, aperiodic and resonant amplifiers. Matching load and generator. Dependence of the amplifier's output power and efficiency on the operating mode of the amplifier element. The power connection of the amplifier. Switching on the load with and without the transformer. Single power amplifier.
7. Operational amplifiers. Classification of operational amplifiers (op-amps). Concept of the Central Committee. Basic parameters, characteristics and typical circuits of an OA. Typical structures and cascades of OA. OA with negative feedback.
8. Usage of operational amplifiers: inverter scale amplifier, non-reverse scale amplifier, differential amplifier. Analog switch (adder) and integrator, AC voltage and output current amplifiers, current amplifiers, amplitude detector, bridge amplifiers. Passive and active filters.
9. Digital combination circuits. The logic, the basic laws, postulates. Types of combination circuits: encoders, Comparators, decoders, parity circuits, drivers, switches, multiplexers, arithmetic-logic devices. The principles of construction and practical usage.
10. Regulatory digital devices. Elementary digital automata (triggers). Control devices: registers, counters, separators, programmable dividers. Functional and concept diagrams, application areas.
11. A semiconductor memory. Types of memory chips: register, dynamic, static, permanent, reprogrammed.
12. The levels of data to describe the microprocessor. Microprocessors and microprocessor systems. Universal microprocessors, microcontrollers (MC), digital signal processors, programmable logic integrated circuits (controllers), their application and main characteristics.
13. The structure of the microprocessor. Basic basic information about the structure and organization of the microprocessor. Internal organization of microprocessors. The structure of the components of the processor (CPU). Principles of interaction of the microprocessor with internal devices of the microprocessor system.
14. Purpose and principle of operation of the microcontroller. Basic information about the basic purpose and principle of operation of the microcontroller. Internal structure of microcontrollers. The architecture of the microcontroller. Application of microcontrollers in industrial automation, measurement technology, communications, home appliances, and many other electronics industries.
15. Architecture and classification of microprocessor systems. Basic information about the architecture and classification of microprocessor systems. Principles of microprocessor systems. Application, implementation methods, classification of microprocessor systems based on construction principles.

## Refereces:

### Main literature:

1. Титце У., Шенк К. Полупроводниковая схемотехника: Справочное руководство – М.: Мир. 1982. – 512 б.
2. Гусев В.Г., Гусев М.Ю. Электроника. – М.: Высш.шк. 1991. – 495 б.
3. Гершунский Б.С. Основы электроники и микроэлектроники: Учебник для вузов – Киев: Высшая школа, 1989. – 424 б.
4. Павлов В.Н., Ногин В.Н. Схемотехника аналоговых электронных устройств. – М.: Радио и связь, 1997. – 320 б.
5. Безгулов Д.А. Калиенко И.В. Цифровые устройства и микропроцессоры. Ростов н/Д: Феникс, 2008 ж., 468 б.
6. Опадчий Ю.Ф., и др. Аналоговая и цифровая электроника (Полный курс) Учебник для вузов./ под ред. О.П. Глудкина. - М.: Горячая линия - Телеком, 2000.
7. Токхэйм Р. Основы цифровой электроники. Пер. с англ. - М.: Мир, 1988 ж. - 392 б.
8. Угрюмов Е.П. Цифровая схемотехника: Учеб. Пособие для вузов. – 2-е изд., перераб. И доп. – СПб.: БХВ-Петербург, 2004. – 800 б.: ил.
9. Бойко В.И. и др. Схемотехника электронных систем. Микропроцессоры и микроконтроллеры/ Авторы: В.И.Бойко, А.Н. Гуржий, В.Я. Жуйков, А.А. Зори, В.М. Спивак, Т.А. Терещенко, Ю.С. Петергеря - СПб.: БХВ-Петербург, 2004. – 464 б.: ил.
10. Корнеев В.В., Киселев А.В. Современные микропроцессоры. – 3-е изд., перераб. И доп. - СПб.: БХВ-Петербург, 2003. – 448 б.: ил.
11. Безуглов Д.А., Калиенко И.В. Цифровые устройства и микропроцессоры. Учебное пособие.- Ростов-на Дону:–Феникс, 2008. – 470 б.

### Additional literature:

1. Опадчий Ю.Ф., и др. Аналоговая и цифровая электроника (Полный курс) Учебник для вузов./ под ред. О.П. Глудкина. – М.: Горячая линия – Телеком, 2000.
2. Степаненко И.П. Основы микроэлектроники: Учеб. пособие для вузов. – М.: Лаборатория Базовых Знаний, 2000. – 488 б.

3. Прянишников В.А. Электроника: Курс лекций. – СПб.: КОРОНА принт, 1998. – 400 б.
4. Букреев И.Н., Горячев В.И., Мансуров Б.М. Микроэлектронные схемы цифровых устройств. - М.: Техносфера, 2009 ж.
5. Каплан Д. Уайт К. Практические основы аналоговых и цифровых схем. - М.: Техносфера., 2006 ж.
6. Максфилд К. Проектирование на ПЛИС. - М.: Додэка XXI, 2007 ж.
7. Кардашев Г.А. Цифровая электроника на ПК. - М.: Горячая линия - Телеком, 2003 ж.
8. Коффрон Дж. Технические средства микропроцессорных систем: Практический курс. Пер. с англ. –М.: Мир, 1983. -344 б., ил.
9. Применение микропроцессоров в системах управления. Пер. с нем. –М.: Мир, 1984,-464 б., ил.

### **Discipline " modern information transfer systems»**

1. The development of networks and information transmission systems. General principles of creating networks and information transmission systems. Simple network. Network software. Knowledge of physical data according to communication networks. Communication issues.
2. Local network technologies in a shared environment. General description of the LAN (local network) protocols. Wireless LAN (local network) IEEE 802.11. Private networks and Bluetooth technology.
3. Commutated Ethernet networks. Switches. Routers. Concentrators. Ethernet types at high speed. The architecture of the switch. The constructive implementation of switches.
4. The coding of sources. Shannon theorems. Speech encoders. Audio and image compression. Errors of coders and the methods of reducing. Modern types of noise correction coding.
5. Modulated signals. Constantly converted signals. AFM signals. Orthogonal signal ensembles. OFDM signals. Receiving signals with a random initial phase. Receiving incoherent signals. Description of demodulators. Determination of the resistance of operation of the demodulators against the noise.
6. Organization of the wireless communication networks. Satellite communication. Cellular communication. Wireless subscriber networks. Wireless local networks. 3G, 4G, 5G cellular communication technologies.
7. Wireless sensor network technology. Development of the wireless sensor network technology. The future of the wireless sensor network development. Structure and topology of the wireless sensor network. Requirements to the network nodes. Wireless sensor network platforms. Setting stages of the wireless sensor network. The model of the OSI network.

Network protocols. Standards for transferring the data in the wireless sensor network. Comparative descriptions of the currently used standards.

8. ZigBee technology of the wireless data. Description of the standard IEEE 802.15.4. Protocol stack of the IEEE 802.15.4/ZigBee. Frequency range, transmission speed, and address of the IEEE 802.15.4. ZigBee network. Forming the algorithm of the FSU according to the ZigBee standard. Dynamics of the network. Directing in the ZigBee network.

9. LoRaWAN technology. Features of the LoRa protocol. Network architecture and radiofrequency of the LoRa network. The main protocol stack of the LoRa. Security in the LoRa networks. Practical implementation by the equipment manufacturers of the LoRaWAN LoRa. Descriptions of the LoRa equipment.

10. Definition of "Online items". Examples and main applications of "Online items". Appearance and development of the "Online Items". Examples of data collected and processed in IoT networks. The concept of the Smart system.

## References:

### Main literature:

1. П.Рошан, Д. Лиэрм. Основы построения беспроводных локальных сетей стандарта 802.11. М., Cisco Systems, 2005, 445 с.
2. Головин О.В. Радиоприемные устройства. – М.: Горячая линияТелеком, 2002.
3. Крук Б.И., Нопантонопуло В.Н., Шувалов В.Н. Телекоммуникационные системы и сети. Современные технологии. Том 1. – М.: Горячая линия-Телеком, 2003.
4. Пескова, С. А.Сети и телекоммуникации : учеб. пособие для студ. вузов. - 3-е изд., стер. - М. : Академия, 2008. - 350 с.
5. Борисов, В. И. Помехозащищенность систем радиосвязи. Вероятностно-временной подход / В.И. Борисов, В.М. Зинчук. - М.: РадиоСофт, 2009. - 260 с.
6. Соболев, Б.В. Сети и телекоммуникации: Учебное пособие / Б.В. Соболев. - Рн/Д: Феникс, 2015. - 522 с.
7. Строганов, М.П. Информационные сети и телекоммуникации. / М.П. Строганов, М.А. Щербаков. - М.: Высшая школа, 2008. - 151 с.

8. Шевченко, В.П. Вычислительные системы, сети и телекоммуникации (для бакалавров) / В.П. Шевченко. - М.: КноРус, 2014. - 224 с.
9. И В Шахнович. Современные технологии беспроводной связи. М., Техносфера, 2006.-288 с.
10. Голдсмит А. Беспроводные коммуникации., М., Техносфера, 2011.-904 с.
11. Макаров С.Б., Певцов Н.В и др. Телекоммуникационные технологии: введение в технологию GSM., М.: 2008. – 256 с.

#### **Additional literature:**

1. Zheng J., Jamalipour A. Wireless sensor networks: a networking perspective. – John Wiley & Sons, 2009.
2. Friedland B. Control system design: an introduction to state-space methods. – Courier Corporation, 2012.
3. Korowajczuk L. LTE, WiMAX and WLAN network design, optimization and performance analysis. – John Wiley & Sons, 2011.
4. Весоловский, К. Системы подвижной радиосвязи / К. Весоловский. - М.: ГЛТ, 2006. - 536 с.
5. Комашинский, В.И. Системы подвижной радиосвязи с пакетной передачей информации / В.И. Комашинский. - М.: ГЛТ, 2007. - 176 с.
6. Никитин, Н.В. Телекоммуникации. Обучение. Профессионализм / Н.В. Никитин, А.Ю. Уваров. - М.: Логос, 2008. - 428 с.
7. Ле Бодик Г., Технологии и службы мобильной передачи данных. SMS, EMS и MMS, М.: Техносфера, 2008. – 544 с.
8. Галкин В.А. Цифровая мобильная радиосвязь. Учебное пособие для вузов. – 2-е изд., М.: Горячая линия-Телеком, 2012. -592 с., ил.
9. Печаткин А.В. Системы мобильной связи (1 часть).- Р.: РГАТА им. П.А. Соловьева, 2007.

**5. "8D07115-electronics and control systems"**  
**Scale of assessment of the results of the exam in the educational program**

Rating by letter system	Quantitative representation of scores	% indicator	Evaluation with the traditional system	The scale of competence
A	4,0	95-100	Excellent	<p>«<b>Excellent</b>» shows a deep knowledge of all program materials, understanding of the relationship between the processes and main provisions of the disciplines. Students must be able to logically construct sufficient, informative, and full-featured accurate answers to additional questions of the exam ticket and members of the Examination Committee. Answers should be from all literature sources.</p>
A-	3,67	90-94		

B+	3,33	85-89	Good	Rating " <b>good</b> " – a clear and sufficient knowledge of all program materials, a correct understanding of the essence and relationship of the processes and phenomena under consideration; consistent, correct, accurate answers to questions raised, related to the free elimination of comments on individual issues.
B	3,0	80-84		
B-	2,67	75-79		
C+	2,33	70-74		



	2,00	50-69	Satisfactorily	Rating " <b>satisfactory</b> " - a clear knowledge and understanding of the main questions of the program, correct and accurate answers, without serious errors, the answers to the questions posed can be satisfied in the examiners' guide.
		0-50	Unsatisfactory	Rating "unsatisfactory" – incorrect answer to at least one of the main questions, rough tolerance, incorrect understanding of the meaning of the questions posed; unreliable answers to additional questions.