Syllabus
Course Program

DEVELOPMENT OF SATELLITE COMMUNICATION NETWORKS

Specialty
172 Electronic communications and radio engineering

Institute
Institute of Computer Modeling, Applied Physics and Mathematics

Educational program
Network technologies and telecommunications

Department
Information systems named after V.O. Kravets (169)

Level of education
Master's r degree

Course type
Elective

Semester
1

Language of instruction
English

Lecturers and course developers

Halyna Sokol

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PhD, Associate Professor of the Department of Information Systems named after V.O. Kravets of NTU "KhPI". Work experience - 17 years. Leading lecturer on disciplines: "Development of satellite communication networks", "Radio relay and satellite transmission systems", "Information communication systems and technologies", "Switching systems in telecommunications".
Learn more about the teacher on the department's website

General information

Abstract

The discipline is aimed at mastering theoretical knowledge and acquiring practical skills in the field of designing and modeling satellite communication networks.

Purpose and objectives of the disciplines

The discipline is aimed at mastering theoretical knowledge and acquiring practical skills in the field of designing and modeling satellite communication networks.

Format of classes

Lectures, practical work, independent work, consultations. The final control is test.

Competences

GC7. Ability to conduct research at an appropriate level.
SC1. Ability to apply scientific facts, concepts, theories, principles, and scientific methodologies of research.
SC 3. The ability to reasonably choose and effectively apply mathematical methods, computer modeling technologies, as well as approaches and methods of electronic optimization communication and radio technical systems, complexes, technologies, devices and their components on at all stages of their life cycle.

SC 7. Ability to find and evaluate information on electronic communications issues, radio equipment and related issues.
SC 8. The ability to solve complex professional problems based on the use of the latest technologies transmission, reception and processing of information.
SC 9. The ability to solve current scientific problems in the field of electronic communications and radio technology with justified use of modern theoretical and experimental research methods.

Learning outcomes

LO4 – to plan and carry out scientific and applied research in the field of telecommunications and radio engineering, to apply methods of mathematical and physical modeling, information processing, interpret research results and justify conclusions.
LO7 - to localize and assess the state of the problem situation at the stages of research, design, modernization, implementation and operation of modern and promising telecommunication and radio engineering systems, complexes, technologies, devices and their components, formulate proposals for its solution with the elimination of identified shortcomings.
LO16 – identify and solve current scientific problems in the field of telecommunications and radio engineering, choose and use effective theoretical and experimental research methods.

Student workload

The total volume of the discipline is 120 hours. (4 ECTS credits): lectures – 32 hours, laboratory work – 32 hours, independent work – 56 hours.

Prerequisites for studying the discipline (prerequisites)

"Switching systems in telecommunications ", " Theory of electrical communication ", " Radio relay and satellite transmission systems ".

Features of the course, teaching and learning methods and technologies

In the course of teaching the discipline, the teacher uses explanatory-illustrative (informational-receptive) and reproductive teaching methods. Presentations, conversations, individual group projects, and master classes are used as teaching methods aimed at activating and stimulating the educational and cognitive activity of applicants.

Program of educational discipline

Topics of lectures

Topic 1. Classification of satellite transmission systems. Subject and structure of discipline, reporting. Frequency bands of satellite communication systems. Peculiarities of propagation of radio waves on satellite communication lines.
Topic 2. Frequency planning of satellite transmission systems. Frequency ranges of satellite transmission systems. Bands of frequencies that stand out in different ranges. Duplex diversity.
Topic 3. Modulation of signals in satellite communication systems. Types of modulation, main parameters of modulation. Communication stability with different types of modulation.
Topic 4. Radio transmitting and receiving devices of satellite systems. General characteristics and classification of radio transmitting and receiving devices. Basic technical parameters of radio transmitters and radio receivers. Determination of the main parameters for the calculation of satellite transmission systems.
Topic 5. Orbits telecommunications artificial earth satellite. Satellite radio visibility zone. Principles of construction satellite transmission systems with multi-station access. Satellite system calculation transfers.
Topic 6. Antennas of satellite transmission systems. Repeater antennas. Antennas of earth stations. Analysis of energy balance in satellite communication systems.
Topic 7. Global navigation satellite systems. Basic concepts and definitions. Classification technical means of navigation. Satellite navigation systems. GPS system structure and principles functioning.

Topic 8. Overview of modern satellite communication systems. Global satellite system Starlink. Thuraya Personal Satellite Communication System. Inmarsat satellite communication system. Iridium satellite communication system. Operation of the Hughes 4200 Portable Satellite Terminal.

Topics of practical classes

There are no practical classes.

Topics of laboratory works

Topic 1. Study of basic concepts and components of satellite networks.
Topic 2. Study of digital modulation methods.
Topic 3. Study of pulse-code modulation.
Topic 4. Calculation of satellite orbits and geostationary positioning.
Topic 5. Calculation of satellite orbits and geostationary positioning.
Topic 6. Designing and analyzing link budgets considering signal losses and gains.
Topic 7. Designing and analyzing link budgets considering signal losses and gains.
Topic 8. Exploration of satellite communication frequency bands and their allocation.
Topic 9. Study of FDMA, TDMA, CDMA, and their applications in satellite networks.
Topic 10. Study of reliability parameters of satellite transmission systems.
Topic 11. Study of reliability parameters of satellite transmission systems.
Topic 12. Global Positioning System (GPS).
Topic 13. Energy parameters of satellite communication lines.
Topic 14. Schematics of digital satellite transmission systems.
Topic 15. Determining the parameters of the satellite broadcasting system.
Topic 16. Implementation of satellite networks for broadcasting, GPS, and IoT.

Independent work

A student's independent work is one of the forms of organization of learning, the main form of mastering educational material in free time from classroom training. During independent work, students study lecture material, prepare for practical work, control work and the exam.

Literature and educational materials

Basic literature:

1. Pratt T., Bostian C.W., and Allnutt J.E. «Satellite Communications», Wiley, 2001, 560 pp. https://www.scribd.com/document/465328829/Timothy-PrattJeremy-E-Allnutt-Satellite-Communications-Wiley-Blackwell-2020-pdf.
2. Springer Handbook of Global Navigation Satellite Systems / Editors: Peter J.G. Teunissen, Oliver Montenbruck (Eds.), Springer, Wienn - New York, 2008, 518 pp. https://link.springer.com/book/10.1007/978-3-319-42928-1.

Additional literature:

1. Galileo Open Service. Signal In Space Interface Control Document (OS SIS ICD). – European Space Agency, 2006. – 192 p.
2. Electromagnetic compatibility of telecommunication systems: Laboratory workshop / N. Zhenyuk, B. Lazurenko, O. Serkov, I. Yatsenko. - Kharkiv: NTU "KhPI", 2021. - 60 pp., fig. 8, tab. 3.

Evaluation system

Criteria for evaluating student performance and distribution of points

100% of the final grade consists of the results of the assessment in the form of test (50%) and the current assessment (50%)
Laboratory works 30
Independent work, individual tasks 20

Rating scale

Total points	National assessment	ECTS
90–100	Perfectly	A
82–89	Fine	B
75–81	Fine	C
64–74	Satisfactorily	D
60–63	Satisfactorily	E
35–59	Unsatisfactory (requires further study)	FX
1–34	Unsatisfactorily (re-study required)	F

Norms of academic ethics and policy of the course

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": show discipline, education, benevolence, honesty, responsibility. Conflict situations should be openly discussed in study groups with the teacher, and if it is impossible to resolve the conflict, it should be brought to the attention of the employees of the institute's directorate.
Regulatory and legal support for the implementation of the principles of academic integrity of NTU "KhPI" is posted on the website:http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Coordination

Syllabus agreed	Date of approval, signature	Head of Department Pavlo PUSTOVOITOV
	Date of approval, signature	Guarantor OP Vitaliy BRESLAVETS