Syllabus
Course Program

Information processes in telecommunication systems

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 level

Course type
Optional

Semester
2

Language of instruction
English

Lecturers and course developers

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Senior lecturer of the department "Information systems named after V. O. Kravets " NTU "KhPI"

Author of more than 30 publications. Lecturer of courses "Mobile Communication Systems", "Access Systems", "Design of Digital Telecommunications Networks", "Information Security in Telecommunications"
More about the lecturer on the department's website

General information

Summary

This course focuses on the study and analysis of information processes in telecommunication systems, including the transmission, processing, and storage of data. Students will explore concepts such as information theory, signal encoding, data compression, and error correction. By combining theoretical knowledge and practical applications, the course equips learners with the skills to optimize and manage information flow in telecommunication networks..

Course objectives and goals

The objective of this course is to provide students with a comprehensive understanding of information processes in telecommunication systems. Students will learn to analyze and optimize data transmission, ensure reliable communication, and implement efficient encoding and compression techniques. The course aims to develop the analytical and technical skills required to design and maintain high-performance telecommunication networks..

Format of classes

Lectures, laboratory classes, consultations, self-study. Final control in the form of an exam.

Competencies

GC 2. Ability to apply knowledge in practical situations.
GC 9. Ability to develop and manage projects.
SC 2. Ability to implement the principles of a systems approach when conducting research into processes that occur in electronic communication and radio engineering systems, complexes and devices.
SC 8. Ability to solve complex professional tasks based on the use of the latest technologies for transmitting, receiving and processing information.

Learning outcomes

LO1 – organize one's own professional, scientific research and innovation activities based on the principles of a systematic approach and scientific research methodology.
LO11 – develop and implement engineering projects, taking into account goals, limitations, social, economic, legal and environmental aspects.

Student workload

The total volume of the course is 120 hours (4 ECTS credits): lectures - 32, laboratory classes - 32 hours, self-study - 56 hours.

Course prerequisites

"Programming", "Switching systems in telecommunications", "Databases","System and software of telecommunications systems", "Access systems".

Features of the course, teaching and learning methods, and technologies

Classes are made interactively using multimedia technologies for lecture presentations and online demonstrations of task execution examples. The lecture classes use explanatory-illustrative, reproductive, problem-oriented methods and the method of critical thinking. Training materials are available for students through OneNote (Class Notebook).

Program of the course

Topics of the lectures

Topic 1. Introduction to Information Processes:
Understanding the role of information processes in telecommunication systems.
Topic 2. Fundamentals of Information Theory:
Exploring key concepts such as entropy, information content, and channel capacity.
Topic 3. Signal Encoding Techniques:
Examining digital and analog encoding methods used in telecommunications.
Topic 4. Data Compression Algorithms:
Understanding lossless and lossy compression techniques and their applications.
Topic 5. Error Detection and Correction:
Exploring techniques such as parity checks, CRC, and Hamming codes for reliable data transmission.
Topic 6. Data Modulation and Demodulation:
Analyzing modulation techniques such as AM, FM, PSK, and QAM.
Topic 7. Multiplexing in Telecommunication Systems:
Understanding TDM, FDM, and CDM methods for efficient use of communication channels.
Topic 8. Information Flow in Networks:
Analyzing data flow and traffic patterns in telecommunication networks.
Topic 9. Protocols for Data Transmission:
Exploring key protocols such as TCP/IP, UDP, and their roles in information processes.
Topic 10. Secure Data Transmission:
Implementing encryption and secure protocols to protect data in transit.
Topic 11. Performance Metrics in Telecommunication Systems:
Measuring and analyzing throughput, latency, jitter, and packet loss.
Topic 12. Advanced Error Correction Methods:
Exploring modern techniques like turbo codes and LDPC codes.

Topic 13. Cloud and Edge Data Processing:
Examining the role of cloud and edge computing in information processes.
Topic 14. Big Data in Telecommunication Systems:
Handling and processing large-scale data in modern telecommunication networks.
Topic 15. Case Studies in Information Processes:
Analyzing real-world examples of data handling in telecommunication systems.
Topic 16. Emerging Trends in Information Processes:
Exploring trends such as AI-driven data analysis and quantum communication..

Topics of the workshops

Not included

Topics of the laboratory classes

Topic 1. Simulation of Information Processes:
Using tools to simulate basic information flow in telecommunication systems.
Topic 2. Implementing Signal Encoding Techniques:
Coding and decoding signals using standard encoding methods.
Topic 3. Data Compression Analysis:
Implementing and comparing compression algorithms like Huffman and LZW.
Topic 4. Error Detection and Correction Simulation:
Simulating error detection and correction techniques in data transmission.
Topic 5. Modulation and Demodulation Experiments:
Exploring and analyzing different modulation schemes using simulation tools.
Topic 6. Multiplexing Techniques Implementation:
Simulating TDM and FDM methods in a network environment.
Topic 7. Data Traffic Analysis:
Analyzing traffic flow and performance metrics in telecommunication systems.
Topic 8. Protocol Implementation and Testing:
Configuring and testing data transmission protocols like TCP/IP.
Topic 9. Secure Communication Setup:
Implementing encryption techniques for secure data transmission.
Topic 10. Performance Evaluation of Communication Systems:
Measuring key performance metrics using network simulation tools.
Topic 11. Advanced Error Correction Implementation:
Simulating advanced error correction methods such as LDPC codes.
Topic 12. Cloud-Based Data Processing:
Implementing and analyzing information processes in a cloud computing environment.
Topic 13. Handling Big Data in Telecommunication Systems:
Using big data tools to process and analyze large datasets.
Topic 14. AI-Driven Data Analysis:
Applying machine learning algorithms to analyze telecommunication data.
Topic 15. Real-Time Information Processing:
Implementing real-time data processing in telecommunication systems.
Topic 16. Final Project – Comprehensive Information System Simulation:
Designing and simulating a complete telecommunication information process.

Self-study

Students are expected to explore advanced concepts in information processes, including modern encoding methods, compression algorithms, and error correction techniques. Independent projects, research papers, and case studies are encouraged to deepen their understanding. Self-directed learning will prepare students for practical challenges and innovations in telecommunication data management.

Course materials and recommended reading

1. Information Theory and Coding by Example by Mark Kelbert and Yuri Suhov (2020)

2. Principles of Digital Communication by Robert G. Gallager (2021)
3. Digital Communications: Fundamentals and Applications by Bernard Sklar and Fredric Harris (2022)
4. Telecommunication Networks: Protocols, Modeling, and Analysis by Mischa Schwartz (2021)
5. Modern Data Compression by David Salomon (2022)
6. Error Control Coding by Shu Lin and Daniel J. Costello Jr. (2023)
7. Big Data and Cloud Computing for Telecommunications by Rahul Sharma (2020)
8. Network Performance and Protocol Optimization by Patrick P. Fuchs (2022)
9. Advanced Error Correction Techniques by Thomas L. Floyd (2023)
10. AI for Telecommunication Systems by Jacek M. Zurada and Sarah P. Anderson (2022)

Assessment and grading

Criteria for assessment of student performance, and the final score structure

The final grade is made up of 100% assessment results in the form of an exam (50%) and current assessment (50%).
Breakdown of the grading:
Laboratory work: 30%
Independent work and computational tasks: 20%

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.
Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Approval

Approved by	Date, signature	Head of the department Pavlo PUSTOVOITOV
	Date, signature	Guarantor of the educational program Vitaliy BRESLAVETS