



Syllabus

Course Program



Information and coding theory

Specialty

F5 Cybersecurity and information protection

Institute

Educational and Scientific Institute of Computer Science and Information Technology

Educational program

Cybersecurity

Department

Cybersecurity (328)

Level of education

Bachelor's level

Course type

Special (professional), Mandatory

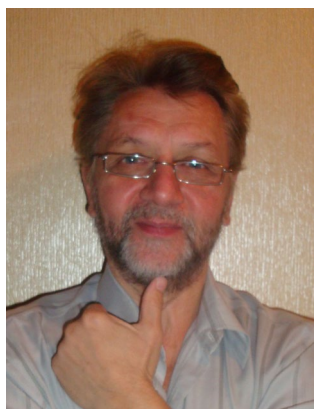
Semester

1

Language of instruction

English

Lecturers and course developers

**Oleksandr MILOV**

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Doctor of technical sciences, professor of the cyber security department of National Technical University "Kharkiv Polytechnic Institute".

Author of more than 200 scientific and educational and methodological works. Academic supervisor for protected candidate theses, guarantor of the educational and professional program of the second (master's) level of higher education. Leading lecturer in the disciplines: "Mathematical foundations of cryptology and cryptanalysis", "Data structures", "Industrial and office espionage", "Digital forensics", for undergraduate and graduate students, Section "Methodology of scientific and pedagogical activity in the sciences of cyber protection" for postgraduate students.

[More about the lecturer on the department's website](#)

**Iryna AKSONOVA**

Iryna.Aksonova@khpi.edu.ua

Candidate of Economic Sciences, Associate Professor of the Department of Cyber Security of National Technical University "Kharkiv Polytechnic Institute".

The number of scientific publications: more than 150, including certificates of authorship - more than 15, chapters in monographs - 10, articles referenced in the scientific metric databases Scopus and WoS - 9. Lecturer in the disciplines: "Modeling of information security systems", "Artificial intelligence and business analytics", "Standardization and certification in the field of information security", "Technology of business process security management" and others for undergraduate and graduate students.

[More about the lecturer on the department's website](#)

General information

Summary

Within the scope of this discipline, students of higher education study the processes of storage, transformation and transmission of information, as well as the properties of codes and their suitability for solving specific problems. In addition, students master the methods of determining the bandwidth of communication channels, sufficient to transmit all incoming information without delays and distortions; study the basic algorithms for building various codes used both for data protection and for their compression.

Course objectives and goals

The purpose of the discipline "Theory of information and coding" is to get acquainted with the technologies of working with information; formation of knowledge and skills necessary for the use of models and methods of transformation of messages and signals; processing and protection of information in case of interference, construction of codes, management of flows in information networks.

Format of classes

Lectures, laboratory classes, consultations, self-study. Final control – exam.

Competencies

GC-1. Ability to apply knowledge in practical situations.

GC-6. The ability to realize own rights and responsibilities as a member of society, to realize the values of a civil (free democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of a person and a citizen in Ukraine.

PC-1. Ability to apply the legislative and regulatory framework, as well as state and international requirements, practices and standards in order to carry out professional activities in the field of information and/or cyber security.

PC-7. Ability to implement and ensure the functioning of complex information protection systems (complexes of regulatory, organizational and technical means and methods, procedures, practical techniques, etc.).

Learning outcomes

LO-1. Apply knowledge of state and foreign languages in order to ensure the effectiveness of professional communication;

LO-2. Organize own professional activity, choose optimal methods and ways of solving complex specialized tasks and practical problems in professional activity, evaluate their effectiveness;

LO-3. Use the results of independent search, analysis and synthesis of information from various sources for the effective solution of specialized tasks of professional activity.

LO-4. Analyze, argue, make decisions when solving complex specialized tasks and practical problems in professional activity, which are characterized by complexity and incomplete determination of conditions, be responsible for the decisions made.

LOR-7. Act on the basis of the legislative and regulatory framework of Ukraine and the requirements of relevant standards, including international ones in the field of information and/or cyber security.

LO-8. Prepare proposals for regulatory acts on ensuring information and/or cyber security.

LO-9. Implement processes based on national and international standards for detection, identification, analysis and response to information and/or cyber security incidents.

LO-10. Perform analysis and decomposition of information and telecommunication systems.

LO-11. Perform analysis of connections between information processes on remote computer systems.

LO-12. Develop threat and intruder models.

LO-16. Implement complex information security systems in the automated systems (AS) of the organization (enterprise) in accordance with the requirements of regulatory and legal documents.

LO-18. Use software and software-hardware complexes for the security of information resources.

LO-19. Apply theories and methods of protection to ensure information security in information and telecommunication systems.

LO-20. Ensure the functioning of special software to protect information from destructive software influences, destructive codes in information and telecommunication systems.

LO-21. Solve tasks of provision and support (including: review, testing, accountability) of the access control system according to the stated security policy in information and telecommunication (automated) systems.

LO-22. Solve the management procedures of identification, authentication, authorization of processes and users in information and telecommunication systems according to the established policy of information and/or cyber security.

LO-24. Solve the problems of managing access to information resources and processes in information and telecommunication (automated) systems based on access management models (mandatory, discretionary, role-based).

LO-27. Solve problems of data flow protection in information and telecommunication (automated) systems.

LO-32. Solve the tasks of managing the processes of restoring the regular functioning of information and telecommunication systems using backup procedures in accordance with the stated security policy.

LO-33. Solve the problems of ensuring the continuity of business processes of the organization on the basis of risk management theory.

LO-34. Participate in the development and implementation of an information security and/or cyber security strategy in accordance with the goals and objectives of the organization.

LO-35. Solve the tasks of providing and supporting complex information security systems, as well as countering unauthorized access to information resources and processes in information and information-telecommunication (automated) systems in accordance with the stated policy of information and/or cyber security.

LO-43. Apply national and international regulatory acts in the field of information security and/or cyber security to investigate incidents.

LO-44. Solve the problems of ensuring the continuity of the organization's business processes on the basis of risk management theory and the stated information security management system, in accordance with national and international requirements and standards.

LO-53. Solve problems of software code analysis for the presence of possible threats.

LO-54. Be aware of the values of a civil (free democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of a person and a citizen in Ukraine.

Student workload

The total volume of the course is 90 hours (3 ECTS credits): lectures - 16 hours, laboratory classes - 16 hours, self-study - 58 hours.

Course prerequisites

Foreign Language, Mathematical foundations of cryptology.

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, and master classes are used as teaching methods aimed at activating and stimulating the educational and cognitive activities of applicants.

Program of the course

Topics of the lectures

Topic 1. Mathematical foundations of information theory.

Topic 2. Information and its quantitative assessments. Entropy of the source of information.

Topic 3. Effective encoding and compression of data.

Topic 4. Information characteristics of communication channels.

Topic 5. Principles and methods of interference-resistant coding.

Topic 6. Cyclic codes. Encoding and decoding methods.

Topics of the workshops

Not provided for in the curriculum.

Topics of the laboratory classes

- Topic 1. Presentation of numerical information in different counting systems.
- Topic 2. Characteristics of a discrete information transmission channel.
- Topic 3. Use of statistical methods of information compression.
- Topic 4. Mathematical models of communication channels.
- Topic 5. Research and study of criteria for evaluating interference-resistant coding.
- Topic 6. Reed-Solomon codes and their use in encoding and decoding.

Self-study

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, do individual homework, prepare for tests, tests and exams. Students are also recommended additional materials (videos, articles) for self-study and analysis.

Non-formal education

Within the framework of non-formal education, according to the relevant Regulation (<http://surf.li/pxsav>), the educational component or its individual topics may be taken into account in the case of independent completion of professional courses/trainings, civic education, online education, vocational training, etc.

Subjects are not considered for this component in case of successful completion of the courses.

Course materials and recommended reading

References

1. Theory of information and coding: a course of lectures [Electronic resource]: education. manual for bachelor's degree holders in specialty 124 "System Analysis" /; comp.: A.E. Kovalenko. Kyiv: KPI named after Igor Sikorskyi, 2020. 248 c.
<https://ela.kpi.ua/items/a07a480f-f5ec-4cbd-9e92-34ffc453b10c>
2. Boyko V.D., Vasylenko M.D., Slatvinska V.M. Theory of information and coding: educational and methodical recommendations (in aid of independent work for applicants of higher education with the bachelor's qualification of the faculty of cyber security and information technologies). Odesa: "Helvetika" Publishing House. 2020. 34 p
https://ekt.elit.sumdu.edu.ua/wp-content/uploads/2023/05/Teoriia-informatsii-ta-koduvannia_Odesa_2020.pdf
3. Podlevskyi B. M. Theory of information in tasks. Center for educational literature. 2019. 271 p..
<https://www.libr.dp.ua/text/kraj/1552407.pdf>

Additional references

1. Kurko A. M. Introduction to the theory of information [Electronic resource]: Guide to the study of the discipline "Theory of information" / A. M. Kurko, V. Ya. Reshetnyak. – Ternopil: Ternopil National Technical University named after Ivan Pulyu, 2017. 108 p. Access mode:
<http://elartu.tntu.edu.ua/handle/lib/21919>
2. Berkman L.N., Bondarchuk A.P., Haydur G.I., Chumak N.S. Coding of information sources and communication channels. Education the manual was prepared for the independent work of students of 305 higher educational institutions according to the credit-modular organization of the educational process. Kyiv: NNITI DUT, 2018. 91p.
<https://duikt.edu.ua/ua/lib/1/category/2530/view/1619?lang=ua&act=view&page=1&category=2530&id=1619>

3. Fundamentals of information theory and coding: laboratory workshop [Electronic resource]: teaching manual for students specialty 171 "Electronics", specialization "Electronic and information technologies of cinematography and audiovisual systems" / M. I. Romanyuk, H. G. Vlasyuk; KPI named after Igor Sikorsky. – Electronic text data (1 file: 2.09 MB). Kyiv: KPI named after Igor Sikorskyi, 2018. 81 p. <https://ela.kpi.ua/items/1cc27217-226a-484b-b8ac-9497ffe37b5>

Assessment and grading

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

Points are awarded according to the following ratio:

- laboratory work: 40% of the semester grade;
- independent work: 10% of the semester grade;
- control work: 10% of the semester grade;
- exam: 40% of the semester grade.

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

28.08.2024



Head of the department

Serhii YEVSEIEV

Date, signature

28.08.2024



Guarantor of the educational program

Serhii YEVSEIEV