Syllabus
Course Program

Security in information and communication systems

Specialty
125 – 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
5

Language of instruction
English

Lecturers and course developers

Roman KOROLEV

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Candidate of economic sciences, associate professor of the department of cybersecurity of National Technical University "Kharkiv Polytechnic Institute".

The number of scientific publications: more than 80, including 12 utility model patents, 1 collective monograph, 2 training manuals, 65 articles in foreign publications and specialized publications of Ukraine, 5 of them in the Scopus scientometric database. Leading lecturer in the disciplines: "Wireless and mobile security", "Fundamentals of steganography", "Business intelligence", "Physical foundations of technical means of intelligence" for undergraduate and graduate students.

More about the lecturer on the department's website

General information

Summary

The educational discipline "Security in information and communication systems" is a mandatory educational discipline. The course aims to equip students with the skills to neutralize common network threats, use SNMP to protect the network, protect against malware, and protect email and web traffic.

Course objectives and goals

Formation of the theoretical foundations of the legislative framework of Ukraine and international society in the field of national and information security of the state, determination of the main requirements for the formation of support and improvement of information security management systems of critical information and communication systems, as well as determination of the place and role of information security in the general system of national security, state and the principles of ensuring information security of the individual, society and the state.

Format of classes

Lectures, laboratory classes, consultations, self-study. Final control - credit test.

Competencies

GC-1. Ability to apply knowledge in practical situations.
GC-2. Knowledge and understanding of the domain and understanding of the profession.
GC-3. Ability to abstract thinking, analysis and synthesis.
GC-4. Ability to identify, state and solve problems in a professional manner.
GC-5. Ability to search, process and analyze information.
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.
GC-7. The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on an understanding of the history and patterns of development of the domain, its place in the general system of knowledge about nature and society and in the development of society, technologies, to use various types and forms of motor activity for active recreation and leading a healthy lifestyle.
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-2. Ability to use information and communication technologies, modern methods and models of information security and/or cyber security.
PC-3. Ability to use software and software-hardware complexes of means of information protection in information and telecommunication (automated) systems.
PC-4. Ability to ensure business continuity in accordance with the established information and/or cyber security policy.
PC-5. The ability to ensure the protection of information processed in information and telecommunication (automated) systems for the purpose of implementing the established information and/or cyber security policy.
PC-6. The ability to restore the regular functioning of information, information and telecommunication (automated) systems after the implementation of threats, cyber attacks, failures and refusal of various classes and origins.
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.).
PC-8. Ability to carry out incident management procedures, conduct investigations, provide them with an assessment.
PC-9. Ability to perform professional activities based on the implemented information and/or cyber security management system.
PC-10. Ability to apply methods and means of cryptographic and technical protection of information at objects of information activity.
PC-11. Ability to monitor the processes of functioning of information, information and telecommunication (automated) systems in accordance with the established policy of information and/or cyber security.
PC-12. Ability to analyze, identify and evaluate possible threats, vulnerabilities and destabilizing factors to the information space and information resources in accordance with the established policy of information and/or cyber security.

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.
LO-5. Adapt under the conditions of frequent changes in the technologies of professional activity, to predict the final result.

LO-6. Critically understand the main theories, principles, methods and concepts in education and professional activity.
LO-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-13. Analyze projects of information and telecommunication systems based on standardized technologies and data transmission protocols.
LO-14. Solve the task of protecting programs and information processed in information and telecommunication systems by hardware and software tools and evaluate the effectiveness of the quality of the decisions made.
LO-15. Use modern hardware and software of information and communication technologies.
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-17. Ensure the processes of security and functioning of information and telecommunication (automated) systems based on practices, skills and knowledge, regarding structural (structural-logical) schemes, network topology, modern architectures and models of security of electronic information resources with a reflection of relationships and information flows, processes for internal and remote components.
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-23. Implement measures to prevent unauthorized access to information resources and processes in information and telecommunication (automated) systems.
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-25. Ensure the introduction of accountability of the access management system to electronic information resources and processes in information and telecommunication (automated) systems using event registration logs, their analysis and stated protection procedures.
LO-26. Implement measures and ensure the implementation of processes of prevention of unauthorized access and protection of information, information and telecommunication (automated) systems based on the reference model of interaction of open systems.
LO-27. Solve problems of data flow protection in information and telecommunication (automated) systems.
LO-28. Analyze and evaluate the effectiveness and level of security of resources of various classes in information and telecommunication (automated) systems during tests in accordance with the established policy of information and/or cyber security.
LO-29. Evaluate the possibility of realization of potential threats of information processed in information and telecommunication systems and the effectiveness of the use of complexes of protection means under the conditions of realization of threats of various classes.
LO-30. Assess the possibility of unauthorized access to elements of information and telecommunication systems.
LO-31. Apply protection theories and methods to ensure the security of elements of information and telecommunication 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-36. Detect dangerous signals of technical means.
LO-37. Measure the parameters of dangerous and interfering signals during the instrumental control of information security processes and determine the effectiveness of information security against leakage through technical channels in accordance with the requirements of regulatory documents of the technical information security system.
LO-38. Interpret the results of special measurements using technical means, monitoring the characteristics of information and telecommunication systems in accordance with the requirements of regulatory documents of the technical information security system.
LO-39. Carry out attestation (based on accounting and survey) of regime territories (zones), premises, etc. under the conditions of compliance with the secrecy regime, recording the results in the relevant documents.
LO–40. Interpret the results of special measurements using technical means, control of ITS characteristics in accordance with the requirements of regulatory documents of the technical information security system.
LO-41. Ensure the continuity of the event and incident logging process based on automated procedures.
LO-42. Implement processes of detection, identification, analysis and response to information and/or cyber security incidents.
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-45. Apply early classes of information security and/or cyber security policies based on risk-based access control to information assets.
LO-46. Analyze and minimize the risks of information processing in information and telecommunication systems.
LO-47. Solve the problems of protection of information processed in information and telecommunication systems using modern methods and means of cryptographic protection of information.
LO-48. Implement and maintain intrusion detection systems and use cryptographic protection components to ensure the required level of information security in information and telecommunications systems.
LO-49. Ensure the proper functioning of the monitoring system of information resources and processes in information and telecommunication systems.
LO-50. Ensure the functioning of software and software-hardware complexes for detecting intrusions of various levels and classes (statistical, signature, statistical-signature).
LO-51. Maintain operational efficiency and ensure configuration of intrusion detection systems in information and telecommunication systems.
LO-52. Use tools for monitoring processes in information and telecommunication systems.
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 120 hours (4 ECTS credits): lectures - 32 hours, laboratory classes - 16 hours, self-study - 72 hours.

Course prerequisites

Basics of cryptographic protection. Fundamentals of mathematical modeling of security 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, 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. Modern threats to network security.
Overview of network topologies. Hacker tools. Malicious software. Typical network attacks. Network protection. Areas of network security. Cisco SecureX architecture. Neutralization of typical network threats.
Topic 2. Ensuring the security of network devices.
Edge router protection. Setting up secure administrative access. Configuration of advanced security features for virtual login. SSH protocol configuration. Assignment of administrative roles. Setting privilege levels. Configuring the CLI based on roles. Management and reporting protection. Using the SNMP protocol to protect the network.
Topic 3. Authentication, authorization and accounting.
AAA review. AAA features. Local AAA authentication. Troubleshooting AAA authentication errors. AAA server communication protocols. AAA server authentication configuration using the command line interface (CLI). Troubleshooting AAA server authentication errors. AAA server authorization configuration.
Topic 4. Implementation of firewall technologies.
Configuring standard and extended IPv4 ACLs using the command line interface (CLI). Neutralization of attacks using ACL-lists. IPv6 ACLs. Protecting networks using firewalls. Types of firewalls.
Topic 5. Implementation of the intrusion prevention system.
Characteristics of IDS and IPS systems. IPS network implementations. Cisco Switched Port Analyzer. Characteristics of IPS signatures. IPS signature actions. Management and monitoring of IPS. IPS Global Correlation. Cisco IOS IPS Configuration Using the Command Line Interface (CLI). Changing Cisco IOS IPS signatures.
Topic 6. Ensuring local network (LAN) security.
Familiarity with end device security. Protection against malicious software. Email and web traffic protection. Network access control. Level 2 security threats. Attacks on CAM tables. Neutralization of the attack on the CAM table. Neutralization of attacks on VLANs. Neutralization of DHCP attacks. Neutralization of ARP attacks. Neutralization of address spoofing attacks. Neutralization of STP attacks.
Topic 7. Cryptographic systems.
Secure communications. Cryptography. Cryptoanalysis. Cryptographic hashes. Ensuring integrity using MD5, SHA-1 and SHA-2 algorithms. Authentication using the HMAC algorithm. Encryption. Data Encryption Standard (DES), AES. Alternative encryption algorithms. Diffie-Hellman key exchange. Digital signature.
Topic 8. Implementation of virtual private networks (VPN).
Overview of VPN networks. VPN technologies. Introduction to the IPsec protocol. IPsec protocols. Internet Key Exchange. IPsec VPN configuration between two points (Site-to-Site). ISAKMP policy. IPsec VPN.
Topic 9. Implementation of the multifunctional protection device Cisco Adaptive Security Appliance (ASA).
ASA decision. Basic ASA configuration. ASA firewall configuration. Setting up services and management parameters. Groups of objects. ACLS. Service policies at ASA.
Topic 10. Cisco ASA multifunctional security device with advanced functionality.

ASDM wizards menu. Setting up services and management parameters. Configuration of advanced ASDM features. VPN between two points (Site-to-Site). VPN remote access (Remote-Access). Clientless SSL VPN configuration. SSL VPN configuration using the AnyConnect client.
Topic 11. Management of a secure network.
Network security testing techniques. Network security testing tools. Security Policy Overview. Structure of the security policy. Standards, instructions and procedures. Roles and responsibilities. Safety awareness and training. Responding to a security breach.

Topics of the workshops

Not provided for in the curriculum.

Topics of the laboratory classes

Topic 1. (Cisco). Social engineering. Study of network attacks, as well as tools for security auditing and conducting attacks.
Topic 2. (Cisco). Protecting the router for administrative access.
Topic 3. (Cisco). Protecting administrative access using AAA and RADIUS.
Topic 4. (Cisco). Configuring advanced access control lists (ACLs).
Topic 5. (Cisco). Setting up zonal firewalls.
Topic 6. (Cisco). Intrusion Prevention System (IPS) settings.
Topic 7. (Cisco). Protection of switches of the 2nd level.
Topic 8. (Cisco). Studying methods of spreading.
Topic 9. (Cisco). Site-to-Site VPN configuration using Cisco IOS.

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://surl.li/pxssv), 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.
In particular, certain topics of this component can be taken into account in case of successful completion of the following CISCO courses:
Endpoint Security
https://www.netacad.com/catalogs/learn?category=course.

Course materials and recommended reading

Basic literature:

1. Information protection technologies./ S.E. Ostapov, S.P. Yevseev, O.G. King. – Chernivtsi: Chernivtsi National University, 2013. – 471 p.
http://kist.ntu.edu.ua/textPhD/tzi.pdf.
2. Synergy of building cybersecurity systems: monograph / S. Yevseiev, V. Ponomarenko, O. Laptiev, O. Milov and others. - Kharkiv: PC TECHNOLOGY CENTER, 2021. - 188 p. URL:
https://drive.google.com/drive/u/1/folders/1wOTN8N-GBGO06AnvjQHU1SdBl3xCaUju
3. Models of socio-cyber-physical systems security: monograph / S. Yevseiev, Yu. Khokhlachova, S. Ostapov, O. Laptiev and others. - Kharkiv: PC TECHNOLOGY CENTER, 2023. - 168 p. URL:
https://drive.google.com/drive/u/1/folders/1wOTN8N-GBGO06AnvjQHU1SdBl3xCaUju

4. Modeling of security systems for critical infrastructure facilities: monograph / S. Yevseiev, R. Hryshchuk, K. Molodetska, M. Nazarkevych and others. - Kharkiv: PC TECHNOLOGY CENTER, 2022. - 196 p. URL: https://drive.google.com/drive/u/1/folders/1wOTN8N-GBGO06AnvjQHU1SdBl3xCaUju.

Additional literature:

5. Security of information and communication systems. K.: VNV Publishing Group, 2009. – 608 p. https://is.ipt.kpi.ua/pdf/Graivorovskyi_Novikov.pdf
6. Askoxylakis I., Ioannidis S., Katsikas S.K., Meadows C. (eds.) Computer Security - ESORICS 2016, Part I. https://f.eruditor.link/file/2593296/.

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;
- credit test: 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

28.08.2024 — Head of the department
Serhii YEVSEIEV

28.08.2024 — Guarantor of the educational program
Serhii YEVSEIEV