

Curriculum

To be reviewed by Feb. 2027	Activity number 211	Applied Cryptography	ECTS 1
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<p><u>Target audience</u></p> <p>The participants should be mid-ranking to senior military or civilian officials dealing with information security and cybersecurity from EU Institutions, Bodies and Agencies as well as EU Member States.</p>	<p><u>Aim</u></p> <p>The aim of the course is to provide the main notions of applied cryptography, help the participants to familiarise with the use of hash functions, encryption algorithms and the available encryption tools.</p> <p>Furthermore, this course will allow the participants to exchange views, share best practices on applied cryptography topics by improving their knowledge, skills and competencies in this domain.</p> <p>By the end of this course, the participants will be familiar with the terminology, concepts and tools used in applied cryptography and share views on how to protect data in personal and business environment.</p>
<p>Open to:</p> <ul style="list-style-type: none"> • EU Member States / EU Institutions Bodies and Agencies • Candidate Countries 	

CORRELATION WITH CTG / MTG TRAs	EQUIVALENCES
CTG / MTG TRA on Cyber and the EU Policy on Cyber Defence	<ul style="list-style-type: none"> • <i>Specialised course, at tactical/operational level.</i> • <i>Linked with the strategic objectives of Pillar 2 of the EU's Cybersecurity Strategy for the Digital Decade [16.12.2020 JOIN (2020)]</i>

Learning Outcomes	
Knowledge	<p>LO01. Define the basic notions, terminology and concepts of applied cryptography</p> <p>LO02. Define the basics of Randomness, Abstract Syntax Notation One (ASN.1), Hash functions, symmetric cryptography, asymmetric cryptography, public key infrastructure, public key certificates, digital signatures, transport layer security, cryptographic currency transactions</p> <p>LO03. Define how Blockchain and Cryptocurrency use cryptographic algorithms</p>
Skills	<p>LO04. Produce encrypted from plaintext and the opposite</p> <p>LO05. Produce ASN.1 description language code</p> <p>LO06. Compute bitwise operations</p> <p>LO07. Apply Hash functions, Encryption algorithms, Certificates, TLS</p> <p>LO08. Apply Pretty Good Privacy (PGP) to encrypt and decrypt data and emails</p>

Responsibility and Autonomy	LO09. Create symmetric cryptosystem LO010. Generate Certificates, Public Private Key LO011. Create asymmetric encryption and signing utility
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Evaluation and verification of learning outcomes

The course is evaluated according to the Kirkpatrick model, particularly level 1 evaluation (based on participants' satisfaction with the course) and level 3 evaluation (assessment of participants' long-term change in behaviour after the end of the course). Evaluation feedback is given in the level 1 evaluation of the residential modules.

In order to complete the course, participants have to fulfil all the learning objectives, and are evaluated on the basis of their active contribution to the residential modules, including their teamwork sessions and practical activities, and on their completion of the eLearning phases. Course participants must complete the autonomous knowledge units (AKUs) and pass the tests (mandatory), scoring at least 80% in the incorporated test/quiz. However, no formal verification of the learning outcomes is provided for; the proposed ECTS is based solely on participants' coursework.

The Executive Academic Board takes these factors into account when considering whether to award certificates to participants. Module leaders provide an evaluation report for each residential module. The Course Director is responsible for overall coordination, with the support of the ESDC Secretariat, and drafts the final evaluation report, which is presented to the Executive Academic Board.

Course structure

The residential course is held over three days.

Main Topic	Suggested Residential Working Hours + (Hours required for individual learning, E-Learning etc)	Suggested Contents
1. One Time Pad (OTP)	6 + (3)	1.1. Pseudo-Random Number Generator (PRNG) 1.2. Bitwise operations 1.3. One-Time Pad (OTP)
2. Abstract Syntax Notation One (ASN.1)	10 + (4)	2.1. Types 2.2. Encoding rules 2.3. Distinguished Encoding Rules (DER)
3. Hash functions	4 + (2)	3.1. Data identification and integrity verification 3.2. Hash-based PRNG 3.3. Hash chain 3.4. Hash tree 3.5. Hash-based Message Authentication Code
4. Symmetric cryptography	5 + (2)	4.1. AES 4.2. Block cipher 4.3. Password based
5. Asymmetric cryptography	5 + (2)	5.1. RSA encryption 5.2. Hybrid encryption 5.3. RSA Public and Private key
6. Public Key Infrastructure (PKI) and certificates	10 + (4)	6.1. Certificates 6.2. ElGamal encryption system 6.3. PGP encryption system 6.4. Payment Card Industry Data Security Standards (PCI-DSS) 6.5. Encryption in compliance with industry standards and GDPR

7. Transport Layer Security (TLS)	5 + (2)	7.1. Transport Layer Security overview and characteristics
8. Email security	3	8.1. Encrypting emails
9. Crypto Currencies	5	9.1. Cryptocurrencies transactions (case study) 9.2. Blockchain and the transaction log 9.3. Anonymity 9.4. Post-Quantum Cryptography and the Y2Q threat
TOTAL	48 + (19)	

<u>Material</u>	<u>Methodology</u>
<p>Required:</p> <ul style="list-style-type: none"> • AKU 104: Module 2 – Learn about Information Security <p>Recommended:</p> <ul style="list-style-type: none"> • AKU 1 History and context of the CSDP • ENISA, Algorithms, Key Sizes and Parameters Report, 2013 recommendations from October 2013, https://www.enisa.europa.eu/publications/algorithms-key-sizes-and-parameters-report?v2=1 • ENISA, Post-quantum cryptography, Current state and quantum mitigation from May 2021, https://www.enisa.europa.eu/publications/post-quantum-cryptography-current-state-and-quantum-mitigation • Directive (EU) 2022/2555 of the European Parliament and of the Council of 14 December 2022 concerning measures for a high common level of cybersecurity across the Union (NIS 2) • EU Policy on Cyber Defence, JOIN(22) 49 final, 10.11.2022 • The EU's Cybersecurity Strategy for the Digital Decade (December 2020) • The EU Cybersecurity Act (June 2019) • The EU Cyber Diplomacy Toolbox (June 2017) • Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) • Council conclusions on Strengthening Europe's Cyber Resilience System and Fostering a Competitive and Innovative Cybersecurity Industry (November 2016) 	<p>The course is based on the following methodology: lectures, panels, workshops, exercises and/or case studies</p> <p><u>Additional information</u></p> <p>Pre-course questionnaire on learning expectations and possible briefing topic form specific area of expertise may be used.</p> <p>All course participants have to prepare for the residential module by going through the relevant eLearning preparatory phase, which is mandatory. The materials proposed for supplementary (eLearning) study will reflect current developments in the field of cybersecurity/cyber-defence in general and EU policies in particular. Course participants must be willing to contribute with their specific expertise and experience throughout the course.</p> <p>The Chatham House Rule is applied during all residential modules of the course: "participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed".</p>