INTERNATIONAL TECHNICAL SEMESTER

EUROPEAN COMMON TECHNICAL SEMESTER FOR DEFENCE AND SECURITY (E_uCTS_{DS})

Modules description

Co-funded by the Erasmus+ Programme of the European Union

No.	Code	DISCIPLINES	Didactic activities					Individual study	ECTS
			C	S	L	P	Total		
1.	MS-01	Common Security and Defence Policy	14	28	0	0	42	33	3
2.	MS-02	Integrated Weapon Systems	14	0	28	0	42	33	3
3.	BE-01	Applied Informatics	14	0	28	0	42	33	3
4.	BE-02	Applied Automation for Engineering Systems	14	0	28	0	42	33	3
5.	EI-01 MA-01	A. Signal Processing B. Mechanics and Material Science	14	0	28	0	42	33	3
6.	EI-02 MA-02	A. Programming Languages B. Dynamic of Flight	14	0	28	0	42	33	3
7.	EI-03 MA-04	A. Computer Networks B. Propulsion Systems	14	0	28	0	42	33	3
8.	EI-04 MA-04	A. Microcontrollers B. Computer-Aided-Design and Numerical Analysis	14	0	28	0	42	33	3
9.	Proj	Interdisciplinary Scientific Project	0	0	0	84	84	66	6
10.	ICom	Intercultural communication*	14	14	0	0	28	22	2
11	Sport	Physical Education and Sports*	0	0	28	0	28	22	2
TOTAL			**126**	**42**	**224**	**84**	**476**	**374**	**34**

Countries **LoD-13**	**European Common Technical Semester for Defence and Security**	**Common Security and Defence Policy (CSDP)**	**ECTS 3.0**

Service **Technical/ ALL**	**Minimum Qualification for Lecturers** • **Officers:** o English: Common European Framework of Reference for Languages (CEFR) Level B2 or NATO STANAG Level 3, o Relevant expertise on CSDP, o International experience. • **Civilians:** o English: Common European Framework of Reference for Languages (CEFR) Level B2 or NATO STANAG Level 3, o Expertise on relevant topics, o Relevant academic publications.
Language **English**	
SQF MILOF	• **Competence area** - International Security/Diplomacy Actor • **Learning area** - International organisations • **Organisation level** - Single Arm/Branch

Prerequisites for international participants

- English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2.
- At least 2 years of national (military) education.
- Basic knowledge of International Politics and Relations, EU, CFSP, CSDP. It could be obtained via ESDC Internet Distance Learning.

Aim of the Module

To know the role of different international organisations with implications for security, defence, and conflict management by revealing the interdependencies among major international organisations.

Learning outcomes		
	Know-ledge	Explain the international relations theory • Express interdependencies among international governmental and non-governmental organisations, independent agencies and strategic partners around the world.
	Skills	• Contextualise the military instruments within the national and global security environment in an unpredictable international environment
	Respon-sibility and autonomy	• Take decisions and implement relevant actions necessary to promote an environment conducive to promoting the objectives and principles of international cooperation.

Verification of learning outcomes:

- **Observation**: Students are evaluated during each session, in order to document their understanding of the basic concept of CSDP (20%).
- **Project**: Teamwork project and project defence (40%).
- **Test**: Theoretical part of the Module can be conducted via the e-Learning which includes self-evaluations after each lesson, and final test verifying learned knowledge (40%).

Previous version revised by Col Assoc. Prof. GELL, PhD / IG-Chairman ..... 29 November 2015
New version drafted by Lt Col SPINELLO / Chairman of LoD 8 ..... 31 January 2021
Revised by Col Assoc. Prof. GELL, PhD / IG-Chairman ..... 21 February 2021
Revised according to SQF MILOF by CAPT (N) N. Dimitrov and Assoc. Prof. N. Karadimas / Chairpersons LoD 2/8 ..... 14th of February 2024
Adapted to EuCTSds by COL (AF) Prof. Eng. Cristian-Emil MOLDOVEANU ..... 30th of September 2025

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Module Details			
Topic	**Resi-dential**	**Details**	
The European Union	8	• History • Institutional framework. • Pillar structures	• Achievements • CFSP
CSDP	8	• Structures • European Security Strategy • Crisis management	• Decision-making process • CSDP and the Lisbon Treaty • Europeanisation of officer training
EU missions and operations	8	• Comprehensive approach • Capabilities	• Berlin+ agreement • Lessons learned
EU and partners	4	• UN • NATO • OSCE • AU	• ASEAN • Regional aspects and neighbourhood policy
Horizontal issues	4	• human rights • gender issues	• legal aspects
Recent CSDP initiative	6	• Permanent Structured Cooperation (PESCO) • European Defence Fund (EDF) • Military Planning and Conduct Capability (CPCC) • Coordinated Annual Review on Defence (CARD) • European Intervention Initiative (EI2)	
Future develop-ments	4	• The changing scenario (multipolarism, unipolarism, bipolarism, non polarism) • The new regionalism as a reaction to declining hegemony of superpowers • EU strategic interest in the 21st Century	
Total WH	**42**		
Additional hours (WH) to increase the learning outcomes			
Self-Studies and syndicate work	33	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise students' work in laboratories and exercises to improve skills and consolidate knowledge	
Total WH	**75 3 ECTS**		

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List of Abbreviations:

ASEAN	Association of South-East Asian Nations
AKU	Autonomous Knowledge Unit
AU	African Union
CEFR	Common European Framework of Reference for Languages
CFSP	Common Foreign and Security Policy
CM	Common Module
CSDP	Common Security and Defence Policy
ECTS	European Credit Transfer and Accumulation System
ESS	European Security Strategy
EU	European Union
EUGS	European Union Global Strategy
NATO	North Atlantic Treaty Organization
STANAG	Standardization Agreement
UN	United Nations
WH	Working Hour

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Countries **LoD-13**	**European Technical Semester for Defence and Security**	Common Module **Integrated Weapon Systems**	**ECTS 3.0**

Service **Technical/ ALL** Language **English**	**Minimum Qualification of Instructors** • **Officers or civilian Lecturers:** o English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. o Teaching experience related to the topicp o International experience. o Relevant academic publications.
SQF MILOF	• **Competence area** - Military technician • **Learning area** - Employment of weapon/operating platform/systems • **Organisation level** – Single Arm/Branch / Single Service

Prerequisites for international participants	**Goal of the Module**
• English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • At least 1 year of national (military) higher education. • Basic knowledge of technical systems for security and defence • Security clearance: Unclassified information	• Basic concepts of integrated weapon systems and military technology for defence and security. • Integration, exploitation and analysis of the integrated weapon systems and military technology for defence and security.

Learning outcomes		
	Know-ledge	• Describe the basic concept related to the mission configurations related to the technical systems. • Identify and explain the main characteristics of armament, ammunition systems and military technology and damage mechanisms.
	Skills	• Apply the weaponeering methods to elaborate a mission configuration. • Design scenarios based on integrated weapon systems and military technology for defence and security to underline how the topics treated in the course are used within engineering activity.
	Respon-sibility and autonomy	• Assess the target vulnerability and analyse the effectiveness of selected weapon systems for specific targets subjects. • Compare different scenarios based integrated weapon systems and military technology for defence and security.

Verification of learning outcomes:

- **Observation**: Students are evaluated during each session, in order to document their understanding of the basic concept of integrated weapon systems and military technology for defence and security (20%).
- **Project**: Teamwork project and project defence (40%).
- **Test**: Theoretical part of the Module can be conducted via the e-Learning which includes self-evaluations after each lesson, and final test verifying learned knowledge (40%).

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Module details The content is as an example and depends on the course director's decision			
Main Topic	**Recommended WH**		**Details**
Mission configurations/Military Leadership related to technical systems	6		Management of the modern battlefield by the commander. Transfer of knowledge and skills related to the basic technologies used on the battlefield by developed countries. The goal is to develop military management and leadership skills. **Lecture (2h); Applications (4h).**
Security and defence technical systems characteristics (satellites, radar systems, electronic, communication and IT systems, aircraft, helicopters, UAVs, etc)	6		Transfer of knowledge in technical systems characterising modern military operations in the field. The substantive scope of education includes satellites, radar systems, electronic communication and IT systems, aircraft, helicopters, UAVs. The aim is to provide knowledge about the practical aspects of the discussed technical systems in the context of the modern battlefield. **Lecture (2h); Applications (4h).**
Combat vehicles Characteristics	6		Characteristics of combat vehicles. The goal is to provide knowledge about selected types of technical systems, taking into account their specifications and the scale of destruction **Lecture (2h); Applications (4h).**
Armament and Ammunition System Characteristics and Damage Mechanisms	6		Characteristics of selected armaments and ammunition, taking into account the impact of these armaments and ammunition on selected targets. Description of the destruction process resulting from the use of different types of weapons and ammunition. The goal is to provide knowledge about selected types of ammunition and weapons, taking into account their specifications and the scale of destruction. **Lecture (2h); Applications (4h).**
Armament and Ammunition Systems. Blast and Ballistics/Explosive Engineering	6		Armament and Ammunition Systems characteristics including the modern battlefield conditions. Description of using selected armament and ammunition systems during military operations in specific climatic conditions. Characteristics of selected blast and ballistics technologies due to the modern battlefield conditions. The goal is to provide knowledge of specification of selected armament ammunition systems. **Lecture (2h); Applications (4h).**
Target vulnerability assessment, weapon selection and effectiveness evaluation of selected weapon systems for specific targets (Weaponeering)	6		Transfer of knowledge in the field of target vulnerability assessment, weapon selection and effectiveness evaluation of selected weapon systems for specific targets. The substantive scope of the subject of education includes selected weapon systems for specific targets (Weaponizing). The aim is to provide knowledge about these weapons including technical aspects of using these items in specific conditions of modern battlefield. **Lecture (2h); Applications (4h).**
Aircraft armament&missiles technology & army armament and ordnance	6		Characteristics of selected aircraft armament&missiles technology as well as army armament and ordnance. Description of the methodology of using selected technologies due to modern battlefield conditions. The goal is to provide knowledge of specification of selected aircraft armament&missiles technologies and army armament. **Lecture (2h); Applications (4h).**
Total WH	**30**	**12**	

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Additional hours (WH) to increase the learning outcomes		
Self-Studies and syndicate work	33	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise students' work in laboratories and exercises to improve skills and consolidate knowledge.
Total WH	**75** **3 ECTS**	

List of Abbreviations:

B1, B2 ..... CEFR Levels

CEFR ..... Common European Framework of Reference for Languages

ECTS ..... European Credit Transfer and Accumulation System

WH ..... Working Hour

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Countries **LoD-13**	**European Common Technical Semester for Defence and Security**	Common Module **Applied Informatics**	**ECTS** **3.0**

Service **Technical/ ALL**	**Minimum Qualification of Instructors**
Language **English**	• **Officers or civilian Lecturers:** ○ English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. ○ Teaching experience related to the topic ○ International experience. ○ Relevant academic publications.

Prerequisites for international participants	**Goal of the Module**
• English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • At least 1 year of national (military) higher education. • Basic knowledge of technical systems for security and defence • Security clearance: Unclassified information	• Basic concepts of programming language techniques for defence and security technology applications. • Computer-based problem-solving methods applied in defence and security technology systems.

Learning outcomes		
	Know-ledge	• Demonstrate understanding of fundamental programming language concepts relevant to defence and security technology. • Identify and explain basic algorithms and programming techniques used in defence and security system applications.
	Skills	• Design, develop, and debug simple programs to model and simulate defence and security-related scenarios. • Apply appropriate algorithms and programming methods to solve practical problems in defence and security technology.
	Respon-sibility and autonomy	• Evaluate and improve software performance in defence and security contexts. • Analyse and check the correctness and quality of the algorithms and computer codes.

Verification of learning outcomes:

- **Observation**: Students are evaluated during each session, in order to document their understanding of the basic concept of programming languages applied in defence and security technology applications (20%).
- **Project**: Teamwork project and project defence (40%).
- **Test**: Theoretical part of the Module can be conducted via the e-Learning which includes self-evaluations after each lesson, and final test verifying learned knowledge (40%).

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Module details The content is as an example and depends on the course director's decision		
Main Topic	**Recommended WH**	**Details**
Basic of programming languages	4	**Lecture (2h):** - Data types. The concept of variables and declarations in programming languages. - Functions and libraries. User-defined functions. **Applications (2h):** - Mathematical operations with arrays, vectors, and matrices.
Algorithmization of data processing tasks	4	**Lecture (2h):** - Concept, classification, and methods of description of algorithms. Controlling the flow of information in the algorithm. - Principle of recursive processing and constructing an algorithm: main segment and subroutines. **Applications (2h):** - Iterative algorithms: Iterative algorithms: Program loop: loops with and without a counter. Iterative processing principle. Checking the correctness of the algorithm: tree of consecutive calls and returns, using the stack properties.
Graphical representation of data	4	**Lecture (2h):** - Plotting in two dimensions and three dimensions. **Applications (2h):** - GUI design.
Numerical Integration of Ordinary Differential Equations with MATLAB	12	**Lecture (4h):** - Initial value problem. Runge-Kutta method. - Solving ODE with MATLAB. **Applications (8h):** - Solving a second order ODE. - Modelling of Bullet Trajectory.
Numerical Integration of Ordinary Differential Equations with SIMULINK	10	**Lecture (2h):** - Solving ODE with SIMULINK. - Solving a second order ODE. **Applications (8h)** - Modelling of Bullet Trajectory.
Using specific MATLAB toolboxes	8	**Lecture (2h):** - Structural analysis with MATLAB. **Applications (6h):** - Structural analysis with MATLAB.
Total WH	**42**	
Additional hours (WH) to increase the learning outcomes		

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Self-Studies and syndicate work	33	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise students' work in laboratories and exercises to improve skills and consolidate knowledge
Total WH	**75** **3 ECTS**	

List of Abbreviations:

B1, B2 ..... CEFR Levels

CEFR ..... Common European Framework of Reference for Languages

ECTS ..... European Credit Transfer and Accumulation System

GUI ..... Graphical User Interface

ODE ..... Ordinary Differential Equations

WH ..... Working Hour

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Countries **LoD-13**	**European Common Technical Semester for Defence and Security**	Common Module **Applied Automation of Engineering Systems**	**ECTS 3.0**

Service **Technical/ ALL**	**Minimum Qualification of Instructors**
Language **English**	• **Officers or civilian Lecturers:** ○ English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. ○ Teaching experience related to the topic ○ International experience. ○ Relevant academic publications.

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Prerequisites for international participants	**Goal of the Module**
• English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • At least 1 year of national (military) higher education. • Basic knowledge of technical systems for security and defence • Security clearance: Unclassified information	• Mathematical analysis of linear control systems, stability assessments, control quality, synthesis methods and correction of automation systems' dynamic applied in robotic systems. • Practical matters regarding control and robotics systems.

Learning outcomes		
	Know-ledge	• Explain the main concepts of automation and control theory applied in engineering systems. • Identify the main methods for modelling robotic stations, for programming robots and designing and controlling them.
	Skills	• Measure the properties of control systems and robots, conducting time and frequency analysis. • Design, model and simulate practical control systems and robotic stations, using engineering programming software (environments).
	Respon-sibility and autonomy	• Analyse the control systems and robotics devices in manufacturing processes. • Estimate the need and goal of using automation and robotics systems in practical applications.

Verification of learning outcomes:

- **Observation**: Students are evaluated during each session, in order to document their understanding of the basic concept of applied automation of engineering systems (20%).
- **Project**: Teamwork project and project defence (40%).
- **Test**: Theoretical part of the Module can be conducted via the e-Learning which includes self-evaluations after each lesson, and final test verifying learned knowledge (40%).

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Module details The content is as an example and depends on the course director's decision		
Main Topic	**Recommended WH**	**Details**
Mathematical Models of Automation Systems	6	Creating linear models of control systems such as the transfer-function model, frequency model, state-space model, time and frequency characteristics, characteristics of fundamental dynamic elements, and block diagrams. The classes aim to model, design and simulate some control systems in MATLAB software. • **Lecture (2h):** *- The mathematical description, design, and analysis of automation systems.* • **Applications (4h):** *- Designing and simulation of some control systems using MATLAB software with specialised toolboxes.*
Design the Controller and Synthesis of the Automation Control Systems	6	The types, characteristics, and parameters of the classical controllers. Ziegler-Nichols controller design method. Root locus design method. The classes aim to model, design, and simulate some control systems in MATLAB software. • **Lecture (2h):** *- The design and synthesis issues of the controller in control systems.* • **Applications (4h):** *- The simulation and analysis of some control systems with various controllers using MATLAB software.*
Modelling, Control Design and Experiment of 2 DOF/3 DOF Helicopter	6	Modelling, designing and testing helicopter models mounted on a fixed base with two propellers driven by DC motors. During the model movement, all rotation angles are measured by high-resolution encoders. Laboratories are done by using a graphical programming environment and real-time embedded controllers. • **Lecture (2h):** *- The modelling and design of control systems of the helicopter model.* • **Applications (4h):** *- The laboratory research of the 2 DOF Helicopter model with controller* *- The laboratory research of the 3 DOF Helicopter model with controller*
Modelling, Control Design and Experiment of Inverted Pendulum/ Rotary Double Inverted Pendulum	6	Modelling, designing, and implementing a state-feedback control system that will balance the pendulum in the upright vertical position to a commanded rotary arm angle. Laboratories are done by using a graphical programming environment and real-time embedded controllers. • **Lecture (2h):** *- The modelling and design of a state-feedback control system of the inverted pendulum.* • **Applications (4h):** *- The experimental research on the inverted pendulum.* *- The experimental research on the rotary double inverted pendulum.*

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Introduction to manipulators and robot systems (construction and control)	6	Presentation of the construction of selected types of manipulators, controllers, and control panels. Configuration of the robot system. Presentation of the robot control methodology. • **Lecture (2h):** *- The design, model, and simulate robotic stations.* • **Applications (4h):** *- The experimental research on selected manipulators and robot systems.*
Environments for offline programming of robots	6	Overview of selected environments for offline programming of robots. Acquainting the methodology of offline robot programming. Configuration of the robot system in offline mode. Programming the manipulator movement for a selected task in a virtual environment. Conducting a simulation and analysis of the implemented process. • **Lecture (2h):** *- The overview of environments for robots offline programming.* • **Applications (4h):** *- Programming the manipulator movement for an appointed task in a virtual environment.* *- The experimental research on selected manipulators.*
Selected online robot control systems	6	Overview of selected online robot control systems. Acquainting the methodology of online robot programming. Configuration of the robot system in online mode. Programming the manipulator movement for a selected task in a real environment. Running a real robot and analysing the process being carried out. • **Lecture (2h):** *- The overview of environments for robots online programming.* • **Applications (4h):** *- Programming the manipulator movement for a selected task in a virtual environment.* *- The experimental research on selected manipulators.*
Total WH	**42**	
Additional hours (WH) to increase the learning outcomes		
Self-Studies and syndicate work	33	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise students' work in laboratories and exercises to improve skills and consolidate knowledge.
Total WH	**75** **3 ECTS**	

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List of Abbreviations:

B1, B2 ..... CEFR Levels

CEFR ..... Common European Framework of Reference for Languages

ECTS ..... European Credit Transfer and Accumulation System

WH ..... Working Hour

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Countries **LoD-13**	**European Common Technical Semester for Defence and Security**	Common Module **Signal Processing**	**ECTS** **3.0**

Service **Technical/ ALL**	**Minimum Qualification of Instructors**
Language **English**	• **Officers or civilian Lecturers:** ○ English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. ○ Teaching experience related to the topic ○ International experience ○ Relevant academic publications.

Prerequisites for international participants	**Goal of the Module**
• English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • At least 1 year of national (military) higher education. • Basic knowledge of technical systems for security and defence • Security clearance: Unclassified information	• Basic principles of signals & systems, as well as of signal processing. • Signals & systems and signal-processing techniques: basic techniques of time-/frequency-domain processing. • Practical applications of radars, telecommunications, image processing and pattern recognition.

Learning outcomes		
	Know-ledge	• Master the different steps of sampling, digitalisation and reconstruction of signals. • Explain how to synthesise an analogue/digital filter and to apply techniques for denoising.
	Skills	• Perform spectral analysis, filtering of digital signals using analytical methods and numerical/simulation tools, calculate and analyse the spectrum and power/energy spectral density of a signal • Design, model and simulate practical control systems and robotic stations, using engineering programming software (environments).
	Respon-sibility and autonomy	• Analyse the digital signal processing concepts and methods. • Assess the digital filter with specific characteristics

Verification of learning outcomes:

- **Observation**: Students are evaluated during each session, in order to document their understanding of the basic concept of signal processing (20%).
- **Project**: Teamwork project and project defence (40%).
- **Test**: Theoretical part of the Module can be conducted via the e-Learning which includes self-evaluations after each lesson, and final test verifying learned knowledge (40%).

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Module details The content is as an example and depends on the course director decision		
Main Topic	**Recommended WH**	**Details**
Introduction to the study of signals	6	**Lectures (2h)** *- Mathematical modeling of continuous and numerical signals. Elementary signals. Representation of continuous and numerical signals. Properties and characteristics.* **Exercises/Labs (4h)** *- Graphical representations. Operations with elementary signals.* *- Generation and visualization of periodic and non-periodic signals using dedicated programming environments and laboratory equipment. Teamwork for group project.*
Continuous-Time and Discrete-Time Fourier Transform (CTFT and DTFT)	6	**Lectures (2h)** *- CTFT and Inverse CTFT, DTFT and Inverse DTFT, CTFT and DTFT requirements and properties, common CTFT and DTFT pairs, frequency response of LTI systems, filters.* **Exercises/Labs (4h)** *- Computations of CTFT and DFTF. Applications of CTFT and DTFT for spectral analysis of signals and systems* *- LTI filters and applications. Teamwork for group project.*
Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)	8	**Lectures (2h)** *- From DTFT to DFT, DFT and Inverse DFT, DTFT requirements and properties, the FFT idea, FFT implementations.* **Exercises/Labs (6h)** *- Computations of DFT. Applications of DFT for spectral analysis of signals and systems.* *- FFT decimation in time/frequency. FFT implementations. Spectral leakage and windowing. FFT applications. Teamwork for group project.*
Sampling and Reconstruction	6	**Lectures (2h)** *- Shannon/Nyquist theory, signal sampling, sampling theorem, signal reconstruction, aliasing phenomena and anti-aliasing filters, practical sampling and reconstruction.* **Exercises/Labs (4h)** *- Practical sampling and reconstruction. Anti-aliasing filters. Teamwork for group project.*
Z-Transform (ZT)	10	**Lectures (4h)** *- ZT pairs, relation between ZT and DTFT, ZT of common DT sequences, ZT requirements and properties, ZT applications, digital filters and applications.* **Exercises/Labs (6h)** *- ZT applications. FIR/IIR digital filters. Teamwork for group project.*
Applications of signal processing	6	**Lectures (2h)** *- Case studies of signal processing in civil and military contexts. Specific applications. Integration of artificial intelligence and Internet of Things in signal processing*

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		Exercises/Labs (4h) *- Signal processing-based systems analysis. Simulation of application systems encountered in real life. Teamwork for group project.*
Total WH	**42**	
Additional hours (WH) to increase the learning outcomes		
Self-Studies and syndicate work	33	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise students' work in laboratories and exercises to improve skills and consolidate knowledge.
Total WH	**75** **3 ECTS**	

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List of Abbreviations:

B1, B2 ..... CEFR Levels

CEFR ..... Common European Framework of Reference for Languages

ECTS ..... European Credit Transfer and Accumulation System

DSP ..... Digital Signal Processing

WH ..... Working Hour

Countries **LoD-13**	**European Technical Semester for Defence and Security**	Common Module **Programming languages**	ECTS **3.0**

Service **Technical/ALL**	**Minimum Qualification of Instructors**
Language **English**	• **Officers or civilian Lecturers:** ○ English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. ○ Expertise in relevant topics. ○ Relevant academic publications.

Prerequisites for international participants	**Goal of the Module**
• English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • At least 1 year of national (military) higher education. • At least a basic programming course, preferably C/C++. • Basic knowledge in technical systems for security and defence	• Discover and understand the C programming language • Concepts and constructions across programming languages (C, C++, Python). • Computer-based problem-solving methods applied in defence and security technology systems.

Learning outcomes		
	Know-ledge	• Describe the basic concept of programming languages applied in defence and security technology applications. • Identify the main algorithms and programming language techniques used to solve the basic applications in defence and security technology systems.
	Skills	• Design, implement and debug simple programs for modelling and simulation of basic defence and security phenomena. • Apply programming languages algorithms to solve basic defence and security technology applications.
	Responsibi lity and autonomy	• Analyse and check the correctness and quality of the algorithms and computer codes. • Compare different programming language techniques to better solve applications in the defence and security technology field.

Verification of learning outcomes:

- **Observation**: Throughout the Module students will meet with the systems applications, and they will discuss the given topics in the plenary and present teamwork results. During this workshop, students will be evaluated to verify their competencies.
- **Project**: Teamwork project and project defence.
- **Test**: Final examination at the end of the module.

Created by COL (AF) Prof. Eng. Cristian-Emil MOLDOVEANU - EuCTSds project consortium 17 02 2022
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Module details		
Main Topic	**Recom-mended WH**	**Details**
Basics of the C programming language	8	**Lecture (2h) and Applications (6h):** - Data types and the concept of variables and declarations in C programming. - Types of operators: Arithmetic, Relational, Logical, Bitwise Operators. - Performing mathematical operations with arrays, vectors, and matrices. - Functions and libraries, including user-defined functions. - The Linux operating system. - Laboratory setup. Introduction to Makefile.
Pointers	6	**Lecture (2h) and Applications (4h):** - Concept, pointer arithmetic. - Pointers and arrays. - Function pointers. - Common mistakes.
Dynamic memory allocation	6	**Lecture (2h) and Applications (4h):** - Dynamic memory allocation. - Data structures (lists, stacks, graphs). - Linear Data structures: Queue, Stack, Linked list. - Non-Linear Data structures: Graph, Tree.
Character arrays	6	**Lecture (2h) and Applications (4h):** - Character arrays in C. - Review of functions for character arrays. - Common mistakes with character array in C. - Stack overflow attacks.
Code profiling	6	**Lecture (2h) and Applications (4h):** - Big O notation and code profiling. - Code profiling with Valgrind. - Debugging pointers with Valgrind. - Call Python code from C. - DFT vs. FFT – code profiling.
C vs. C++ memory management	4	**Lecture (2h) and Applications (2h):** - Short introduction to C++ and OOP. - The new and delete operators vs. malloc and free. - Pointers and references.
Python memory management	6	**Lecture (2h) and Applications (4h):** - Introduction to Python. - Garbage collection.
Total WH	**42**	
Additional hours (WH) to increase the learning outcomes		
Self-Studies and syndicate work	33	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise the work of students in laboratories and exercises to improve skills and consolidate knowledge.
Total WH	**75**	

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BIBLIOGRAPHY:

1. Zed. A. Shaw. Learn C the hard way. http://c.learncodethehardway.org/book/
2. Brian Kernighan, Dennis Ritchie. The C programming language. Prentice Hall, 1988,
3. Al Sweigart. Automate the boring stuff with Python. Practical programming for total beginners. No starch press. Internet: https://automatetheboringstuff.com/#toc
4. Valgrind documentation. Internet: https://valgrind.org/docs/download_docs.html
5. Course presentations.

List of Abbreviations:

B1, B2 ..... CEFR Levels

CEFR ..... Common European Framework of Reference for Languages

ECTS ..... European Credit Transfer and Accumulation System

GUI ..... Graphical User Interface

ODE ..... Ordinary Differential Equations

WH ..... Working Hour

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Countries	European Technical Semester for Defence and Security	Common Module	ECTS
LoD-13		**Computer Networks**	**3.0**

Service	Minimum Qualification of Instructors
Technical/ ALL	• **Officers or civilian Lecturers:** ○ English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. ○ Teaching experience related to the topic ○ International experience. ○ Relevant academic publications.
Language **English**	

Prerequisites for international participants	**Goal of the Module**
English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. At least 1 year of national (military) higher education. Basic knowledge of technical systems for security and defence • Security clearance: Unclassified information	• Computer network topologies, network architectures, digital data transfer, packets, protocols and network processes, reference network models and hierarchical layers. • Basic network device configuration.

Learning outcomes		
	Know-ledge	• Explain the structures and functions of computer communication components, the computer communication protocols, the role, interaction and operation of the components of communication systems. • Identify the security implications regarding planning, deployment and operation of network equipment and services.
	Skills	• Use of tools for analysis and testing communication protocols. • Design a connection diagram to connect and configure selected elements of the computer network using appropriate methods, techniques and tools by the given specification.
	Responsibi lity and autonomy	• Analyse the properties of network components and systems. • Estimate the need and goal of using computer networks in practical applications.

Verification of learning outcomes:

- **Observation**: Students are evaluated during each session, in order to document their understanding of the basic concept of computer networks (20%).
- **Project**: Teamwork project and project defence (40%).
- **Test**: Theoretical part of the Module can be conducted via the e-Learning which includes self-evaluations after each lesson, and final test verifying learned knowledge (40%).

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Module details

The content is as an example and depends on the course director decision

Main Topic	Recommended WH	Details
OSI Model for computer networks. Application layer	10	**Lection: 2 h**. Principles of open system network models - layers and protocols. Network applications and services – dns, http (https), email, ssh, rdp. **Lab exercise (practice): 8 h**. Network components. Basic services. Addressing. Building and testing a basic network topology. Encapsulation.
Transport layer	6	**Lection: 4 h**. Transport-layer services in computer networks. Connectionless transport with UDP. Connection-oriented transport with TCP. Header fields. Network congestion control. **Lab exercise (practice): 2 h**. TCP segments and UDP datagrams inspection in a computer network. Usage of simulation software and/or Wireshark.
Network layer	10	**Lection: 4 h**. Logical addresses in computer networks. Internet Protocol version 4 (IPv4). Header fields. IPv4 Addressing. Internet Protocol version 6 (IPv6). Header fields. Static-routing configuration **Lab exercise (practice): 6 h**. Classful and classless IPv4 address space calculation. IPv4 and IPv6 packets inspection with simulation software and/or Wireshark.
Data-Link layer	4	**Lection: 2 h**. Data-link layer protocols. Ethernet frame structure. MPLS service. MAC addresses and switch CAM (MAC) tables. **Lab exercise (practice): 2 h**. LAN frames switching inspection with simulation software and/or hardware devices.
Computer networks physical layer	10	**Lection: 2 h**. Computer network cabling and interface connectors – UTP; STP (Foiled TP) with RJ-45; fiber-optics (SFP, GBIC, SC, LC, MU). Wireless LAN standard (IEEE802.11). Cellular internet access (HSPA, LTE). **Lab exercise (practice): 8 h**. Cabling a computer network. Building a small network. Computer network and services inspection with simulation software or by means of hardware devices. Wi-Fi monitoring.
Final Exam	2	Theoretical test – 1 h. Practical exam (group project) – 1 h.
Total WH	**42**	

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Additional hours (WH) to increase the learning outcomes		
Self-Studies and syndicate work	33	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise students' work in laboratories and exercises to improve skills and consolidate knowledge.
Total WH	**75 3 ECTS**	

BIBLIOGRAPHY:

1. William Stallings, “Data and Computer Communications, 8/E”, Prentice Hall, 2007
2. Andrew Tanenbaum, “Computer Networks, 5/E”, Prentice Hall, 2013
3. James F. Kurose, Keith W. Ross, „Computer Networking: A Top-Down Approach (7th Edition)”, 2017

List of Abbreviations:

B1, B2 _____ CEFR Levels

CEFR _____ Common European Framework of Reference for Languages

ECTS _____ European Credit Transfer and Accumulation System

WH _____ Working Hour

Co-funded by the Erasmus+ Programme of the European Union

Countries **LoD-13**	**European Technical Semester for Defence and Security**	Common Module **Microcontrollers**	**ECTS 3.0**

Service **Technical/ ALL**	**Minimum Qualification of Instructors**
Language **English**	• **Officers or civilian Lecturers:** ○ English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. ○ Teaching experience related to the topic ○ International experience. ○ Relevant academic publications.

Prerequisites for international participants	**Goal of the Module**
• English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • At least 1 year of national (military) higher education. • Basic knowledge of technical systems for security and defence • Security clearance: Unclassified information	• Basic concepts of architecture and operation of typical microprocessors and microcontrollers. • Foundation for designing real world applications using microprocessors and microcontrollers. • Programming and interfacing of microprocessors and microcontrollers.

Learning outcomes		
	Know-ledge	• Describe the basic principles of Microcontroller based design and development • Explain the state-of-the-art interfacing technologies, their potential applications and their market views
	Skills	• Design and build functional prototypes for real-world applications. • Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller.
	Respon-sibility and autonomy	• Compare accepted standards and guidelines to select the appropriate Microprocessor and Microcontroller to meet specified performance requirements. • Analyse assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.

Verification of learning outcomes:

- **Observation**: Students are evaluated during each session, in order to document their understanding of the basic concept of microcontrollers (20%).
- **Project**: Teamwork project and project defence (40%).
- **Test**: Theoretical part of the Module can be conducted via the e-Learning which includes self-evaluations after each lesson, and final test verifying learned knowledge (40%).

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Module details

The content is as an example and depends on the course director's decision

Main Topic	Recommended WH	Details
Introduction to microprocessors and microcontrollers.	6	Definitions and types of processors. Differences between microprocessor and microcontroller. Construction and operation of the processor of 8-bit AVR microcontrollers. Main functional blocks and microprocessor registers. Electrical parameters, power supply systems, generating the clock signal and resetting the microprocessor. Characteristics of the most popular microcontroller families. (Lecturer 2, Applications 4h)
Organization of program and data memory, methods and elements of microcontroller programming	6	. Structure of a RAM and ROM memory cell. Memory map and organization of Flash, EEPROM and SRAM memory in AVR microcontrollers. Microcontroller programming languages. Program (runtime) environments. Program structure and application software development cycle. Programming methods, access and protection of Flash memory contents. EEPROM memory support . (Lecturer 2, Applications 4h)
Basic input-output circuits and the interrupt system of microcontrollers.	6	Construction of ports - basic input and output circuits of microcontrollers. Port lines in input / output mode with required properties. Dedicated registers for handling ports and input-output lines. Interrupt sources, interrupt vector. Interrupt service registers. Interrupt handling functions. Examples of handling interrupts from a digital input. (Lecturer 2, Applications 4h)
Timer-counter systems of microcontroller	6	Operation of basic timer-counters. Clock signal sources for counters. Configure the subsystem of counters / timers in compare and capture mode. The use and program service of timer-counters to generate pulses with a given time and square waveforms with a given frequency, filling and shift. The use and program service of timer-counters to measure the pulse duration, period and filling of a square wave, shift between two waveforms. (Lecturer 2, Applications 4h)
Specialized input-output systems of microcontrollers (analog comparators, A / C and C / A converters).	6	Construction of comparators, analog-to-digital (A / C) and digital-to-analog (D / A) converters used in AVR microcontrollers. Review of registers for A / C and D / A converters. Interrupts generated by these devices. Programming of converters without and with the use of interrupts. (Lecturer 2, Applications 4h)
Built-in drivers for serial transmission	6	. Characteristics of USART, I2C (TWI) and SPI transmission standards. Construction of USART, TWI and SPI controllers in microcontrollers of the AVR family. Registers and program service of individual interfaces. Usage and handling of interrupts generated by USART, TWI and SPI controllers. (Lecturer 2, Applications 4h)

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Organization of the microprocessor system, examples of ready-made hardware platforms.	6	The concept of a microprocessor system. Microprocessor environment systems. Specialized circuits and input / output devices. Program support for SD memory, matrix keyboard, LED displays, character and graphic LCD displays and electric motors. Examples of ready-made microprocessor systems (e.g. Arduino) and SoC platforms (e.g. Raspberry Pi, Banana Pi) . (Lecturer 2, Applications 4h)
Total WH	**42**	
Additional hours (WH) to increase the learning outcomes		
Self-Studies and syndicate work	33	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise students' work in laboratories and exercises to improve skills and consolidate knowledge.
Total WH	**75 3 ECTS**	

List of Abbreviations:

B1, B2 ..... CEFR Levels

CEFR ..... Common European Framework of Reference for Languages

ECTS ..... European Credit Transfer and Accumulation System

WH ..... Working Hour

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Countries **LoD-13**	**European Common Technical Semester for Defence and Security**	Common Module **Mechanics and Material Science**	**ECTS 3.0**

Service **Technical/ ALL**	**Minimum Qualification of Instructors**
Language **English**	• **Officers or civilian Lecturers:** ○ English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. ○ Teaching experience related to the topic ○ International experience. ○ Relevant academic publications.

Prerequisites for international participants	**Goal of the Module**
• English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • At least 1 year of national (military) higher education. • Basic knowledge of technical systems for security and defence • Security clearance: Unclassified information	• Basic principle of mechanics and material Science. • Geometrical characteristics of materials, the stress-strain relationship, the schematisation of real, physical elements and the loads acting them. • Modelling tools for mechanics and material science

Learning outcomes		
	Know-ledge	• Describe the basic concepts related to the mechanics of various systems, statically determinate or indeterminate and the basic concepts related to the strength of materials: stresses, strains and their relation. • Identify the basic equations needed for a system to be in equilibrium and the determination of its stress diagrams.
	Skills	• Compute the geometrical characteristics of a given cross-section, the axial stress, shear stress and bending moment diagrams in a given system. • Apply the modelling tools to determine the axial stress, shear stress and bending moment diagrams in a given system and to interpret the results.
	Respon-sibility and autonomy	• Analyse and represent various systems of bodies having different supports and being subjected to different types of actions. • Promoting logical, convergent and divergent reasoning, practical applicability and evaluation in decision-making.

Verification of learning outcomes:

- **Observation**: Students are evaluated during each session, in order to document their understanding of the basic concept of mechanics and material science (20%).
- **Project**: Teamwork project and project defence (40%).
- **Test**: Theoretical part of the Module can be conducted via the e-Learning which includes self-evaluations after each lesson, and final test verifying learned knowledge (40%).

Created by COL (AF) Prof. Eng. Cristian-Emil MOLDOVEANU - EuCTSds project consortium 17 02 2022
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Module details

The content is as an example and depends on the course director's decision

Main Topic	Recommended WH	Details
Introduction to Mechanics and Strength of Materials	6	**Lecturer (2h)** - the aim of the course, basic assumptions, and short history. - specific problems related to Mechanics and Strength of Materials. - classification of bodies. **Applications (4h):** - internal forces and external forces. - stresses, specific deformations, characteristic curves. - mechanical properties of materials.
Geometric characteristics	6	**Lecturer (2h)** - static moments and moments of inertia and radii of gyration. - resistance modulus. - Variation of the moments of inertia when changing the reference system. Main directions and moments of inertia **Applications (4h):** - computing the geometric characteristics for various cross-section shapes (I, T, L).
Elements of Statics of Systems	6	**Lecturer (4h)** - physical model vs. mathematical model. - actions and reactions. - supports convention. **Applications (2h):** - statically determinate/ indeterminate systems. - diagrams.
Axial stress	6	**Lecturer (4h)** - tensions, specific deformations, displacements. **Applications (2h):** - calculus relations.
Shear stress and bending moment	6	**Lecturer (2h)** - shearing small section elements and the duality of tangential stresses. - simple bending, tensions, specific deformations, displacements. - calculus relations **Applications (4h):** - computations and representations of the axial stress, shear stress and bending moment diagrams for various systems. - computations and representations of the axial stress, shear stress and bending moment diagrams for a truss.
Schematisation of elements and actions. Calculation of reactions.	6	**Applications (6h)**: - schematisation of static determinate and indeterminate systems of actions and supports. - equilibrium equations and calculation of the reactions.

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Modeling a static system and obtaining the stress diagrams	6	**Applications (6h)**: - defining material properties. - choosing and defining section properties. - choosing and modelling the right support conditions for a system. - obtaining and interpreting the stress diagrams.
Total WH	**42**	
Additional hours (WH) to increase the learning outcomes		
Self-Studies and syndicate work	33	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise students' work in laboratories and exercises to improve skills and consolidate knowledge
Total WH	**75** **3 ECTS**	

List of Abbreviations:

B1, B2 ..... CEFR Levels

CEFR ..... Common European Framework of Reference for Languages

ECTS ..... European Credit Transfer and Accumulation System

GUI ..... Graphical User Interface

ODE ..... Ordinary Differential Equations

WH ..... Working Hour

PROJECT NO 2020-1-RO01-KA203-080375
Co-funded by the Erasmus+ Programme of the European Union

Countries **LoD-13**	**European Common Technical Semester for Defence and Security**	Common Module **Dynamic of Flight**	**ECTS** **3.0**

Service **Technical/ ALL**	**Minimum Qualification of Instructors**
Language **English**	• **Officers or civilian Lecturers:** ○ English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. ○ Teaching experience related to the topic ○ International experience. ○ Relevant academic publications.

Prerequisites for international participants	**Goal of the Module**
• English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • At least 1 year of national (military) higher education. • Basic knowledge of technical systems for security and defence • Security clearance: Unclassified information	• Basic principles of the fluid mechanics, aerodynamics and dynamic of flight: boundary layer, laminar and turbulent flows, aerodynamic forces and moments, external ballistics, 6-DOF trajectory • Practical application of fluid mechanics, aerodynamics and dynamic of flight using CFD tools and MATLAB programming language.

Learning outcomes		
	Know-ledge	• Describe the basic concept of fluid mechanics, aerodynamics and dynamic of flight used the in security and defence field. • Explain the basic fluid mechanics, aerodynamics and dynamic of flight equations and the main principles relevant to aerodynamic forces, moment and aerodynamic coefficients, 6-DOF trajectories.
	Skills	• Calculate the aerodynamic forces and moments, aerodynamic coefficients and 6-DOF trajectories, based on CFD tools and Matlab programming language • Design scenarios based on real applications and practical problems to underline how the topics treated in the course are used within engineering activity.
	Respon-sibility and autonomy	• Analyse the trends in development of the new technologies in the security and defence and their potential future application, based on fluid mechanics, aerodynamics and dynamic of flight concepts. • Compare the numerical results of fluid mechanics, aerodynamics and dynamic of flight simulations with the real phenomenon from defence and security technology field.

Verification of learning outcomes:

- **Observation**: Students are evaluated during each session, in order to document their understanding of the basic concept of fluid mechanics, aerodynamics and dynamic of flight (20%).
- **Project**: Teamwork project and project defence (40%).
- **Test**: Theoretical part of the Module can be conducted via the e-Learning which includes self-evaluations after each lesson, and final test verifying learned knowledge (40%).

PROJECT NO 2020-1-RO01-KA203-080375

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Module details The content is as an example and depends on the course director decision		
Main Topic	**Recommended WH**	**Details**
Basic Concepts and Laws of Fluid Mechanics	6	Basic problem of fluid mechanics. Properties of fluids. Forces acting in fluids. Methods of fluid motion analysis, local motion of a fluid element. Basic equations of fluid mechanics (Lec:2h, Lab:4h) **Applications**: *- Determination of the pressure resistance coefficient of a circular profile. Resistance of axisymmetric bodies* *- Determination of the pressure coefficient and total drag coefficient. Determination of differences*
Dynamics of viscous fluids. Wave phenomena in the dynamics of gases, the influence of gas compressibility	6	Dynamics of viscous fluids. Navier - Stokes equation. Boundary layer. The similarity of flows. Friction and pressure resistance, well-flown bodies. Resultant forces acting on the streamlined body - coefficients of aerodynamic forces and moments (Lec:2h, Lab:4h) **Applications**: *1. Analytical solution of Navier - Stokes equations. Calculation of flow parameters using the equation of motion for selected specific flow cases.* *2. First integrals of Euler's equation. Application of the Bernoulli equation in calculating the flow parameters using basic measuring instruments - Pitot tube and Ventouri. Bernoulli's equation in pressure form - static, dynamic and total pressure*
Turbulence modelling	6	- Averaged Navier-Stokes equations (RANS). Turbulence modelling. - Average Navier-Stokes equations. Turbulent stress tensor, the so-called Reynolds. Application of turbulence models. An introduction to computational fluid dynamics (CFD). - Fluid Mechanics. Boundary layers. Stability, transition and turbulence. Heat transfer. **Applications**: *1. Experimental measurement of the boundary layer thickness on a flat plate. Identification of laminar and turbulent boundary layer regions.* *2. Determination of the local and average frictional coefficient over the flat plate. Calculation of the drag force.* (Lec:2h, Lab:4h)
Basic concepts of exterior ballistics and dynamic of flight. Basic definitions, forces and moments	6	- Exterior ballistics. Drag force, spin damping moment, lift and normal forces, overturning moment, Magnus force and moment. Center of pressure of the normal force and the magnus force. - External Ballistics. Forces acting on the projectile. Standard atmosphere. Stabilizing projectile during flight. Ballistic coefficients. Projectile drop. - Drag resistance. Transonic problem. Gyroscopic and Coriolis drift, Magnus and Poisson effect. Empirical and Doppler measurement methods. (Lec:2h, Lab:4h) **Applications**: *- Description of flying objects motion. Reference systems applied in exterior ballistics.*

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Point mass trajectory, modified point mass trajectory, 6-DOF trajectory	6	- Equations of motion. Constant Drag Coefficient, Drag coefficient inversely proportional to Mach number, and to the square root of Mach number. Change of independent variable from time to distance. Numerical solution of the equations of motions. Standard atmospheres for point-mass trajectories. Initial conditions for 6-DOF trajectories and MPM trajectories. Numerical solution for 6-DOF and MPM trajectories. Examples of 6-DOF and MPM trajectories. Generalized Missile Equations of Motion. Coordinate Systems. Rigid-Body Equations of Motion.(Lec:2h, Lab:4h) **Applications**: - *Point mass trajectory, modified point mass trajectory, 6-DOF trajectory*
Aircraft perfomance	6	- Physical nature of drag and classical drag measurements. Airflow regimes. Effect of projectile shape on drag, drag of smooth spheres. Effect of yaw on drag and minimum drag projectile shapes. Equations of motion. Firing uphill and downhill. (Lec:2h, Lab:4h) **Applications**: - *Measurement of aerodynamic forces and moments.*
Basic Concepts of Navigation and Dynamic of guided missiles/aircrafts	6	System Design and Missile Mathematical Model. The Missile Guidance System Model. Autopilots. Aerodynamics. Missile Guidance Laws. Guidance Intercept Techniques. Missile Equations of Motion. Fundamental Guidance Equations. Proportional Navigation. (Lec:2h, Lab:4h)
Total WH	**42**	
Additional hours (WH) to increase the learning outcomes		
Self-Studies and syndicate work	33	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise students' work in laboratories and exercises to improve skills and consolidate knowledge
Total WH	**75 3 ECTS**	

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ECTS ..... European Credit Transfer and Accumulation System

GUI ..... Graphical User Interface

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PROJECT NO 2020-1-RO01-KA203-080375
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Countries **LoD-13**	**European Common Technical Semester for Defence and Security**	Common Module **Propulsion systems**	**ECTS 3.0**

Service **Technical/ ALL**	**Minimum Qualification of Instructors**
Language **English**	• **Officers or civilian Lecturers:** ○ English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. ○ Teaching experience related to the topic ○ International experience. ○ Relevant academic publications.

Prerequisites for international participants	**Goal of the Module**
• English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • At least 1 year of national (military) higher education. • Basic knowledge of technical systems for security and defence • Security clearance: Unclassified information	• Basic concepts of propulsion systems for military aircrafts, gun design and interior ballistics. • Thermodynamic principles of air breading/fossil-derived fuel powered systems.

Learning outcomes		
	Know-ledge	• Describe the mechanical and thermodynamics principles of propulsion systems for military aircrafts, as well as the basic concept of the gun design and interior ballistics. • Identify different types of engines and basic principles of ballistic systems design and the main factors affecting engine selection and ballistic systems design.
	Skills	• Design programs for modelling and simulation of propulsion systems for military aircrafts, as well as the interior ballistics of guns. • Apply mechanical and thermodynamics principles of propulsion systems to solve basic defence and security technology applications.
	Respon-sibility and autonomy	• Analyse the trends in development of the new technologies in the security and defence and their potential future application, based on principles of propulsion systems for military aircrafts, as well as the basic concept of the gun design and interior ballistics. • Compare the numerical results of propulsion systems and interior ballistics simulations with the real phenomenon from defence and security technology field.

Verification of learning outcomes:

- **Observation**: Students are evaluated during each session, in order to document their understanding of the basic concept of propulsion systems (20%).
- **Project**: Teamwork project and project defence (40%).
- **Test**: Theoretical part of the Module can be conducted via the e-Learning which includes self-evaluations after each lesson, and final test verifying learned knowledge (40%).

PROJECT NO 2020-1-RO01-KA203-080375

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Module details The content is as an example and depends on the course director's decision		
Main Topic	**Recommended WH**	**Details**
Energy balance and equations of state	10	**Lecture (4h) and Applications (6h)** Thermodynamic systems. The first law of thermodynamics. Thermodynamic functions and potentials. Equation of state of ideal gas. Equations of state of real gases.
Bernoulli equation - conditions for critical flow and flow through the nozzles	10	**Lecture (4h) and Applications (6h)** Nozzles. Mass and energy conservation equations. Conditions for critical flow.
Basic construction of aircraft engines	10	**Lecture (2h) and Applications (8h)** Types engines and applications
Propulsion in ballistic systems	6	**Lecture (2h) and Applications (4h):** - Types of ballistic systems. - Types of propellants. - Ballistic characteristics. - Experimental determination of impulse and covolume for a small calibre propellant
Modelling/simulation of fundamental problem of interior ballistics for classical artillery systems	6	**Lecture (2h) and Applications (4h):** - General consideration regarding fundamental problem of interior ballistics. - Energy losses. - Necessary equations for an interior balistic model. - Solving the differential equations system in Mathcad/Matlab.
Total WH	**42**	
Additional hours (WH) to increase the learning outcomes		
Self-Studies and syndicate work	33	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise students' work in laboratories and exercises to improve skills and consolidate knowledge.

List of Abbreviations:

B1, B2 ..... CEFR Levels

CEFR ..... Common European Framework of Reference for Languages

ECTS ..... European Credit Transfer and Accumulation System

GUI ..... Graphical User Interface

ODE ..... Ordinary Differential Equations

WH ..... Working Hour

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Countries **LoD-13**	**European Common Technical Semester for Defence and Security**	Common Module **Computer Aided Desing and Numerical Analysis**	**ECTS 3.0**

Service **Technical/ ALL**	**Minimum Qualification of Instructors**
Language **English**	• **Officers or civilian Lecturers:** o English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. o Teaching experience related to the topic o International experience. o Relevant academic publications.

Prerequisites for international participants	**Goal of the Module**
• English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • At least 1 year of national (military) higher education. • Basic knowledge of technical systems for security and defence • Security clearance: Unclassified information	• Basic concepts of Computer-Aided Design (CAD) and Computer-Aided Engineering (CEA) applied in defence and security technology systems. • Application of advanced 3D modelling techniques used to define the geometry of objects described by free form surfaces. Implementation of devices like 3D scanners and CT in the designing process will be discussed. • Fundamentals of preparation of Finite Elements Models, the definition of initial-boundary conditions, interpretation of obtained results of strength analysis will be discussed.

Learning outcomes		
	Know-ledge	• Explain the designing process, Feature-based and Boolean algebra modelling techniques, free-form surface modelling techniques, fundamentals of technical drawings, application of reverse engineering, • Identify the methods used in Finite Elements Analysis, strength analysis of mechanical objects, multibody analysis, kinematic and dynamic motion studies, parametric and topology optimisation.
	Skills	• Design mechanical objects and mechanisms using the 3D CAD system/ assemblie. • Operate the 3D scanner, use the collected digital data from 3D measurements and conduct engineering strength analysis.
	Respon-sibility and autonomy	• Evaluate the correctness of mechanism operating based on the results of motion studies. • Compare the numerical results of obtained based on Computer Aided Desing and numerical analysis with the real phenomenon from defence and security technology field.

Verification of learning outcomes:

- **Observation**: Students are evaluated during each session, in order to document their understanding of the basic concept of the CAD and numerical analysis (20%).
- **Project**: Teamwork project and project defence (40%).
- **Test**: Theoretical part of the Module can be conducted via the e-Learning which includes self-evaluations after each lesson, and final test verifying learned knowledge (40%).

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Module details The content is as an example and depends on the course director's decision		
Main Topic	**Recommended WH**	**Details**
Characterisation of Computer Aided Design (CAD) systems, classification, main functionalities and range of their application	6	Characterisation of Computer Aided Design (CAD) systems, classification, main functionalities and range of their application. (Lec.: 2h; Applications.: 4h) *Application of feature based and Boolean algebra functions, familiarisation with various commends used during 3D modelling process, application of geometrical and dimensional relations, creating of mechanical parts 3D models with different geometrical features, definition of assemblies 3D models, preparation of technical drawing based on 3D models.* **Applications**: - Modeling of 3D parts and assemblies definition in CAD SolidWorks system - Advanced tools available in a 3D parts modelling process
Advanced methods of 3D modeling process with the use of Reverse Engineering	6	Advanced methods of 3D design with the use of Reverse Engineering (Lec.: 2h; Applications.: 4h) *Characterisation of various surface modelling techniques, free-form design, application of 3D scanners and CT, functionalities of reverse engineering software, characterisation of the geometrical quality control process.* **Applications**: - Practical application of 3D scanner and reverse engineering in a 3D modelling process
Characterisation of available CAD tools dedicated to specific design applications	6	Characterisation of CAD tools dedicated to specific design applications (Lec.: 2h; Applications.: 4h) **Applications**: - Design process of weldmetal and sheetmetal objects in SolidWorks CAD system - How to design objects made from plastics? Design process of mold tools
Characterisation of Computer Aided Engineering (CAE) systems	6	Characterisation of Computer Aided Engineering (CAE) systems, classification, main functionalities and range of their application (Lec:2h, Ex:4h) **Applications**: - Quick verification of engineering project correctness in SolidWorks system (4h)
Introduction to Finite Element Analysis (FEA)	6	Introduction to Finite Element Analysis, characterisation of implicite and explicite numerical solving procedure, definition of initial-boundary condition, preparation of Finite Elements models, application of various FE elements, (Lec.: 2h; Applications.: 4h) • **Applications**: - Introduction to Ansys Workbench, various approaches of definition the FE models (4h)
Application of Finite Element Analysis in engineering practice	6	Characterisation of mechanical strength analysis (under quasi-static, dynamic loading conditions), thermal analysis, introduction to optimisation (parametric and topology)

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		studies. (Lec.: 2h; Applications.: 4h) • **Applications**: - Mechanical strength analysis in Ansys Workbench - Introduction to parametric and topology mechanical optimisation
Rigid body motion analysis with the use of CAE systems	6	Introduction to Multi Body Analysis (MBA), practical application of CAE software in motion studies, Degrees of Freedom definition in models, geometrical relations, kinematic and dynamic analysis, parametric optimisation. (Lec.: 2h; Applications.: 4h) **Applications**: - Introduction to rigid Multi Body Analysis (2h) - Studies of mechanism correctness based on the results of motion analysis (4h)
Total WH	**42**	
Additional hours (WH) to increase the learning outcomes		
Self-Studies and syndicate work	33	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise students' work in laboratories and exercises to improve skills and consolidate knowledge
Total WH	**75** **3 ECTS**	

List of Abbreviations:

B1, B2 ..... CEFR Levels

CEFR ..... Common European Framework of Reference for Languages

ECTS ..... European Credit Transfer and Accumulation System

CAD ..... Computer Aided Design

CAE ..... Computer Aided Engineering

CT ..... Computer Tomography

RE ..... Reverse Engineering

WH ..... Working Hour

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Countries **LoD-13**	**European Common Technical Semester for Defence and Security**	Common Module **Intercultural communication**	**ECTS 2.0**

Service **Technical/ ALL** Language **English**	**Minimum Qualification of Instructors** • **Officers or civilian Lecturers:** o English: Common European Framework of Reference for Languages (CEFR) Level B2 or min. NATO STANAG 6001 Level 3. o Teaching experience related to the topic o International experience. o Relevant academic publications.
SQF MILOF	• **Competence area** - Communicator • **Learning area** - Influence operations; strategic communications and media • **Organisation level** – common

Prerequisites for international participants	**Goal of the Module**
• English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • At least 1 year of national (military) higher education. • Basic knowledge of technical systems for security and defence • Security clearance: Unclassified information	• Basic concepts of the communication theory, challenges and threats in a cross-cultural environment. • Theories of culture and communication that help students/cadets to gain valuable skills for overcoming obstacles in crisis situations in a cross-cultural environment. • Linguistic competencies in host country language and the ability to perceive the phenomena of the host country culture and civilization from the cultural diversity point of view .

Learning outcomes	Know-ledge	• Describe the basic concepts related to intercultural and professional communication used in the security and defence field. • Identify the terminology that enables him/her to express opinions, present arguments and give feedback on intercultural and professional communication topics.
	Skills	• Apply the intercultural communication notions and concepts in various professional contexts. • Gives examples of real applications and practical problems to underline how the topics treated in the course are used within the engineering activity;
	Respon-sibility and autonomy	• Argue the necessity of intercultural and professional communication support for efficiently navigating various professional contexts within the engineering activity. • Analyse the trends in the development of intercultural and professional communication and their potential future impact.

Verification of learning outcomes:

- **Observation**: Students are evaluated during each session, in order to document their understanding of the basic concept of intercultural communication and the linguistic competencies in the host country language (20%).
- **Project**: Teamwork project and project defence (40%).
- **Test**: Theoretical part of the Module can be conducted via the e-Learning which includes self-evaluation after each lesson, and final test verifying acquired knowledge (40%).

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Module details the content is as an example and depends on the course director decision		
Main Topic	**Recommended WH**	**Details**
Foundations of Intercultural and Professional Communication	6	**Lecture (2h)**: - The Global Perspective of Intercultural Communication - Specifics of the Host Country Language and Culture **Applications (6h)**: Communication Across Cultures - Obstacles of Perception; Obstacles in Verbal Processes; Obstacles in Nonverbal Processes - Host Country Language: Grammar and Vocabulary
Host Country Culture, Military Communication, Context and Power	6	**Lecture (4h):** - Military Communication in Intercultural Contexts - Cultural Awareness - Host Country Language as a Tool - Host Country Language Grammar and Vocabulary **Applications (6h)**: - How Communication Reinforces Culture - Communication as Resistance to the Dominant Cultural System - Host Country Language: Grammar and Vocabulary
Identity and Intercultural Communication	4	**Lecture (2h):** - Social and Cultural Identities. Personal Identity - Identity, Stereotypes and Prejudices in the host country and Abroad **Applications (6h)**: - Identity Development Issues in the Military. Managing Intercultural Conflict - Gender Identity; Sexual Identity; Age Identity; Racial and Ethnic Identities; Religious Identity; Class Identity; National Identity; Regional Identity; Gender, Ethnicity, and Conflict in the Army - Host Country Language: Grammar and Vocabulary
Language, Globalization and Nonverbal Codes	6	**Lecture (2h):** - Cultural Variations in Communication Style - The Power "Effects" of Labels - The Universality of Nonverbal Behaviour - Nonverbal Military Communication **Applications (6h)**: - Identity Development Issues in the Military. Managing Intercultural Conflict - Code Switching; Language Politics and Policies; Military Terminology Challenges - Host Country Language: Grammar and Vocabulary
Intercultural Relationships and Conflict	6	**Lecturer(4h):** - Strategies and Tactics for Dealing with Conflict - Productive Versus Destructive Conflict. Competition Versus Cooperation **Applications (4h)**: - Final project defence.
Total WH	**28**	

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Additional hours (WH) to increase the learning outcomes		
Self-Studies and syndicate work	22	• Enhancing knowledge by studying specific documents. • Preparation for the group project. • Teamwork for the group project. • Those hours comprise students' work in laboratories and exercises to improve skills and consolidate knowledge.
Total WH	**50** **2 ECTS**	

List of Abbreviations:

B1, B2 ..... CEFR Levels

CEFR ..... Common European Framework of Reference for Languages

ECTS ..... European Credit Transfer and Accumulation System

WH ..... Working Hour

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EUROPEAN COMMON TECHNICAL SEMESTER FOR DEFENCE AND SECURITY (EuCTS_DS)

PROJECT NO 2020-1-RO01-KA203-080375

Interdisciplinary Scientific Project

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CONTENT

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1. The aims of the Interdisciplinary Scientific Project

The aim of the interdisciplinary scientific project is to train students in teamwork and emphasize realistic and real-life situations applied in defence and security technical systems, to demonstrate the ability to use modern design tools and techniques, to demonstrate the ability to plan and run a team-based project and to show the ability to communicate clearly in writing (through a proper project report) as well as by other means.

The work has to be completed within the time schedule and to be presented at an assessment meeting simulated as a board meeting. Great attention is paid to the ability to plan, delegate, communicate and co-operate as a team towards a common objective. The cohesive process needs to be organised so that the team members develop shared commitments and work collectively to achieve objectives that are agreed.

2. Objectives of the Interdisciplinary Scientific Project

After completing the Interdisciplinary Scientific Project, the student should be able to:

- contribute actively as an individual in the group work.
- work alone, independent of the group, in context and co-operation with the team.
- understand the professional responsibilities of the member team in context with different task.

3. Role of the project coordinator

Every student will have his/her project coordinator by an academic member of staff. The scientific coordinator tutor will:

- make themselves available for regular meetings for the duration of the project.
- Organise scientific trip in industrial facilities, laboratory or military units.
- advise on the compilation of the project proposal forms.
- advise on the project's aims, objectives and structure.
- give technical advice and support.
- arrange laboratory facilities, equipment, and space as required.
- procure any agreed material that is required.
- be involved with the interim and final assessments.
- advise on the format and contents of the written report.

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4. Requirements of the student

- identify and distribute the project task among the team member, under the supervision of the scientific coordinator.
- attend and keep near perfect time keeping out of respect for the team members.
- arrange to have regular meetings the scientific coordinator and with the team member.
- start working on the project straight away and work steadily, do not leave it to the last minute.
- submit the interim assessment to the scientific coordinator by the due date.
- write the final written report.
- prepare for and attend the oral presentations.

5. Teamwork activity

The interdisciplinary scientific project requires to work in a team with other students from different countries/institutions/specialisations. Once the student is assigned to the project and to a team, considering the competences, knowledge and skills, a certain task will be distributes with the project. Among the main responsibilities: work as individual or as a team, take minutes, prepare and present intermediary reports, deal with unexpected problems, learn to communicate effectively within the team, prepare reports and prepare and deliver presentations.

6. Intermediary reports

The students will meet your scientific coordinators at least once a week, for about 1 hour, during which time you the student will be able to update on the progress of the work and receive support and guidance on the functioning of the team and of the project.

At least once at 2 weeks, the team has to present the intermediary results in front of the scientific coordinator and of the other teams. The student who will present the intermediary results has to be choose by rotation.

Reports and presentations must not be viewed as competitive but a shared outcome where the students and the project benefits from your involvement and participation. The format of the report will be discussed with the scientific coordinator.

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The midterm report should be of around 15 pages, including figures, tables and all sources and citations. The presentation needs to provide all the information that the student knows about the project, how he is tackling the problem. How the team is functioning to solve the problem, a summary on what has been achieved to date and the plans for the following weeks. Each individual must contribute.

7. Final report

The Final report must be substantial in that it must reflect the activities of the project team in reaching their goals. It will have the same format of content as the midterm report but will require fuller descriptions of the project, the research carried out, the solution to the problem (describing all the facets, options and why the selected option was chosen), the business case, the marketing, the finance statement, how the team functioned, conclusions and all the necessary supporting documentation in the appendices. A report of 30-100 pages, excluding appendices, would not be unreasonable but this is only a guideline and depends on the project, its outcomes, and final conclusions.

First has to be described the objective of the project. Remember it may be reviewed by a variety of academics and industrialists who may not be familiar with the specifics of the project. Revised and updated targets, the project plan, Gantt Chart, team members, the management structure and organisation of the whole Project until the end. Remember to forecast clearly, what the team want to achieve (and what not), how the objective will be achieved it and how the team finally was organised. Present important achievements identified during the project.

8. The final presentation

In the last week of the activity the member team has to present the project, based on a Power point presentation. Timeframe: 30 minutes is allocated for each team presentation, followed by a question-and-answer session (around 20 min). The total time should not exceed 50 min for each team. Everybody in the team must present their chosen part/contribution on preferably what he/she is in charge of in the team.

With group projects each team depends on every member to contribute. Sometimes some students will contribute little or nothing to the group's effort. Therefore to ensure that all team members are fully motivated, a Peer Assessment system will be used, which enables all team members to grade the contribution of themselves and each team member. This means that each student can influence the marks of the other member of the team.

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