

Country BG	Institution NVNA	Common Module Naval Communications	ECTS 2.0
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Service(s): Navy	Minimum Qualification of Instructors:
Language: English	
SQF MILOF:	<ul style="list-style-type: none"> • PhD degree in Electrical Engineering. • English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • Competence area – Military technician. • Learning area – Employment of weapon/ operating platform/ systems. • Organisational level – Single Arm/Branch.

Prerequisites for participants:	Contents of the Module:
<ul style="list-style-type: none"> • English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • Elements of real, complex and vector calculus, electromagnetics and wave physics, and basic circuit theory. 	<ul style="list-style-type: none"> • Technical specifications of relevant naval communications. • Effective exploitation of the relevant naval communications with due consideration of safety measures.

Learning outcomes	Know-ledge	<ul style="list-style-type: none"> • Perform review of the characteristics and possibilities of the naval communications (spectral concepts and techniques, analogue and digital modulation, basic propagation mechanisms and characteristics, antennas and wireless links, satellite links, GMDSS). • Formulate the basics of naval communications management in the sustainment realm of operations.
	Skills	<ul style="list-style-type: none"> • Organise a frequency plan taking into consideration the skills and restrictions of naval training and appropriate propagation techniques for each use case. • Deal with terrestrial and satellite communication systems and the associated multiple access techniques to the satellite resource; GMDSS systems.
	Respon-sibility & Autonomy	<ul style="list-style-type: none"> • Make accountable tactical decisions by developing and adapting the naval force communications plan, managing onboard communications autonomously across different warfare/situational scenarios, and ensuring continuity of communications and adherence to prescribed safety measures and procedures (incl. GMDSS where applicable). • Assume responsibility for comms governance by documenting key planning/operational settings and escalating degradations, interference, or suspected misuse/cyber compromise through the chain of command.

Verification of learning outcomes:
<ul style="list-style-type: none"> • Observation: the theoretical part will be uploaded as study resources for students on the e-platform, as well as simulation programs in GNU Octave. • Tests: the assessment strategy is based on a pre-post assessment method and a personal interview in laboratory premises. • Evaluation: the observation and the practical exercises in the lab result in the overall grading of the module. Qualified individual feedback will be provided to participants.

Module details:

Main Topic	Recom- mended WH <small>for the residential phase</small>	Details
Spectral analysis and discretisation of signals	3	<ul style="list-style-type: none"> Fourier transform and related techniques (convolution, FFT). Application to LTI systems. A/D conversion – sampling and quantisation; The sampling theorem. Frequency bands and spectrum allocation; Classification of emissions.
Fundamentals of analogue and digital transmission	5	<ul style="list-style-type: none"> AM modulation (DSB, DSBSC, SSB). Frequency (up-/down) conversion and the superheterodyne principle. FM modulation; FM spectrum and the Carson rule. Digital networks; Protocol hierarchies. Baseband signalling and line coding. Basic digital modulation schemes (ASK, FSK, BPSK, QPSK, QAM).
Electromagnetic waves and propagation	3	<ul style="list-style-type: none"> Maxwell equations in differential and time-harmonic form. Fundamentals of planar electromagnetic waves: field calculation, phase velocity and intrinsic impedance; Polarisation; Spherical waves. Power flux: The Poynting vector.
Antenna radiation	4	<ul style="list-style-type: none"> Far-field and near-field region; Radiated power. Radiation intensity – Radiation Pattern; Directivity and Gain. Antenna input impedance – Equivalent circuit for transmission. Application to dipoles: Current distribution, Radiation pattern, Directivity, Input impedance.
Wireless links	3	<ul style="list-style-type: none"> Reciprocity theorem for antennas; Equivalent circuit for reception – Self impedance. Antenna effective aperture and relation to directivity Friis transmission equation and radar range equation. Link budget.
Tutorials – laboratory exercise	2	<ul style="list-style-type: none"> Spectrum analyser: principle of operation and use. Spectral analysis of RF signals and characterisation of frequency generators.
	2	<ul style="list-style-type: none"> Computer simulations of analogue signals and modulators / demodulators by use of FFT and other programming blocks.
	2	<ul style="list-style-type: none"> Antenna pattern and gain measurements.
Total WH <small>(contact hours)</small>	18+6	
Additional hours (WH) to increase and assess the learning outcomes (during residential phase):		
Self-studies	25	<ul style="list-style-type: none"> NATO rules and regulations for Naval Communication and Naval Sensors. Cristea O. (coord.), Naval Communication, INS manual, 2025.
Test/evaluation / assessment	1	<ul style="list-style-type: none"> Pre-Post Assessment and Laboratory evaluation.
Total WH	50	The detailed amount of hours for the respective main topic is up to the course director according to national law or the home institution's rules.



List of Abbreviations:

B1, B2, C1	CEFR Levels
BG	Bulgaria
BIP	Blended Intensive Programme
CEFR	Common European Framework of Reference for Languages
ECTS	European Credit Transfer and Accumulation System
ESDC	European Security and Defence College
GMDSS	Global Maritime Distress and Safety System
IG	Implementation Group
IMO	International Maritime Organisation
ITU	International Telecommunication Union
LTI	Linear Time Invariant
NATO	North Atlantic Treaty Organization
NVNA	Nikola Vaptsarov Naval Academy
SOLAS	Safety of Life at Seas
STANAG	Standardisation Agreement
STCW	Standards of Training Certification and Watchkeeping
VSAT	Very Small Aperture Terminal
WH	Working Hour (60 minutes)