Erasmus Course
Measurements in telecommunications

National Military University "Vasil Levski"
Doc.: Erasmus
Date: 28-06-2022
Origin: BG VELIKO02

Country BULGARIA	Institution Vasil Levski National Military University	Course **Measurements in telecommunications**	ECTS **4.0**

Service **ICT** Languages **English, Bulgarian**	Minimum Qualification for Lecturers • English: Common European Framework of Reference for Languages (CEFR) Level B2 or NATO STANAG 6001 Level 2. • Communication equipment. • Communication Networks. • Signals and systems.

Prerequisites for international participants: • English: Common European Framework of Reference for Languages (CEFR) Level B1 or NATO STANAG Level 2. • 3rd year of national (military) higher education. • Knowledge of computer systems and computer networks.	Goal of the Course: • Presentation of communication channels. • Presentation of open system network models. • Skills for modelling basic communication channels. • Skills for modelling basic communication systems. • Exploration of developed real system models.

Learning outcomes	Knowledge	• Signals and systems; • Waveforms; • Modulations.
	Skills	• Signals measurements; • Communication channels measurements; • Distortion measurements; • Frequency counting.
	Competences	• Analog communications; • Digital communications; • Describing waveforms and their efficiency in a function of bandwidth.

Verification of learning outcomes

- **Observation**: Throughout the course students are to accomplish different practical tasks individually or in teams. This course has two chapters. During the tasks students are to be evaluated for competences.
- **Test**: At the end of each chapter, the students have to accomplish specific practical tasks, which include usage of measurement instruments and techniques learned throughout the course.

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Study topics	class hours	Details
Module Details		
Chapter I "RF measurements fundamentals"		
Introduction to RF measurements. Role and significance of measurements in communications	10	• Principle of operation of oscilloscopes. Multichannel, stroboscopic, speed oscilloscopes. Memory oscilloscopes. Oscilloscopes with program control. • RF signal generators. Principles of building RF generators. • Introduction to RF hardware and software tools
Principle of operation of oscilloscopes. Multichannel, stroboscopic, speed oscilloscopes	10	• Examination of signal generators • Measurement of voltage at high frequencies. • Measurement of frequencies and time intervals.
Chapter II "Measurements of voltage, power and current at high frequencies"		
Measurement of power and current at high and ultrahigh frequencies	10	• Voltage measurement at medium and high frequencies. General information, requirements and characteristics. Functional diagrams and principle of operation of analog electronic voltmeters. • Measurement of power and current at high and ultrahigh frequencies. Features of measuring high frequency currents • Measurements of time intervals using oscilloscopes. Digital methods for measuring time intervals
Measurement of modulated signals. Overview	15	• Measurement of modulated signals. • Overview. Amplitude modulation measurements. Measurements in frequency modulation. • Spectral analysis of amplitude and frequency modulation (frequency domain.)
Additional hours to increase the learning outcomes		
Self-Study	30	• Enhancing knowledge by studying specific real systems models and standards. • Reflection of the topics issued.
Total	45	**Lections: 20 Practice: 25**

This study course description is created and revised at "Communication network and systems" Department and accepted at "Artillery, Air Defense and CIS" Faculty council.

Developed by:

major, assist. prof.   PhD Linko Nikolov

REFERENCES:
1. John G. Proakis, Masoud Salehi, "Digital Communications" – 5th ed., McGraw Hill, 2008.
2. Giordano, Levesque, „Modeling of digital communication systems using SIMULINK"

3. „1xEV-DO Revision A + B" White Paper, Rohde & Schwarz GmbH & Co. KG Mühldorfstraße 15 | D - 81671 München

4. 3GPP2 C.S0024; cdma2000 High Rate Packet Data Air Interface Specification; Version C.S0024-B v3.0; June 2012 {Revision B}