COURSE DESCRIPTION CARD - SYLLABUS

Course name
Cybersecurity for Unmanned Aerial Vehicles and satellite systems [S1Cybez1>BSBiS]

Course

Field of study
Cybersecurity

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
24

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
30

Number of credit points

4,00

Coordinators

dr hab. inż. Rafał Krenz
rafal.krenz@put.poznan.pl

dr inż. Michał Sybis
michal.sybis@put.poznan.pl

Lecturers

Prerequisites

Basic knowledge of physics, with emphasis on EM wave propagation and phenomenas like reflection, diffraction, attenuation and dispertion. Basic knowledge of analog and digital wireless communication system and related techniques, e.g. modulation, demodulation, coding, etc.

Course objective

The course aims to familiarize the student with the structure and operation of unmanned and satellite systems and analyze potential threats and attacks.

Course-related learning outcomes

Knowledge:
1. He/she knows the basic building blocks of Unmanned Aerial Vehicles (UAV) as well as satellite systems.[K1_W07]
2. He/she understands the typical threats and the countermeasures applied in UAVs and SatComms.

[K1_W10][K1_W15]
3. He/she is familiar with signal processing techniques, e.g. modulation and coding, applied in the systems. [K1_W07]

Skills:
1. He/she can analyse the link power budget and design a general structure of a radio link for UAVs and SatComms.[K1_U04]
2. He/she is able to select the type of the system suitable for specific applications.[K1_U05]
3. He/she can evaluate and verify the security and immuity of the system to the threats and attacks [K1_U07]

Social competences:
1. He/she understands the importance of UAV and satellite systems security and the impact on different aspects of business and society.[K1_K03]
2. He/she is able to understand and proceed with new threats created every day by novel technologies.[K1_U01]
3. He/she can clearly explain the issues related to security of UAV and satellite systems to both specialists and non-specialists.[K1_K02] [K1_K03]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes are verified based on writen/oral exam consisting of 3-8 questions from the list of 20-25 topics.
Students' knowledge and skills acquired during project-based classes are assessed through a final project, which can be carried out individually or in a team, depending on the task's nature. The project evaluation includes both the substantive aspect and the quality of execution, as well as, in the case of teamwork, the contribution of individual group members to the completion of the task.
In each form of the course assessment, the grade depends on the number of points the student earns relative to the maximum number of required points. Earning at least 50% of the possible points is a prerequisite for passing. The relationship between the grade and the number of points is defined by the Study Regulations. Additionally, the course completion rules and the exact passing thresholds will be communicated to students at the beginning of the semester through the university’s electronic systems and during the first class meeting (in each form of classes).

Programme content

The course presents fundamentals of Unmanned Aerial Vehicles and satellite systems as well as their vulnerability to threats and attacks in cyberspace. The subsystem, including power supply, orientation control, thermal control, communication modules and antennas are discussed. Topics related to radio link, power budget analysis, propagation phenomenas and link performance are presented. The analysis of possible threats and attacks and their countermeasures is introduced for aeronautical, space and ground segments.

Course topics

1. Introduction. Kepler’s Laws. Satellite orbits.
2. Space and ground segment. Satellite bus and payload. Satellite subsystems.
3. Unmanned Aerial Vehicles types. On-board subsystems in fixed-wing and multi-rotor drones.
4. Radio link fundamentals. Link power budget analysis.
5. Radio link performance on the uplink and the downlink. Statistical analysis of link performance.
6. Transmission Impairments. Radiowave Propagation Mechanisms for UAVs and SatComms.
7. Analysis of threats and attacks on UAVs and satellite systems.
8. Detection and localisation of attackers and jammers.
9. Protection of aeronautical, space and ground segments against threats and attacks.
10. Satellite mobile communication systems. INMARSAT. Globalstar. Iridium. Orbcomm. StarLink.
11. Practical short-, medium- and long-range Unmanned Aerial Vehicles.

Teaching methods

Multimedia presentation based lectures with analysis and discussion of real-life examples. Lecture notes

available on-line. The lectures may be held face-to-face, on-line or in hybrid mode.
Project-based classes are conducted using the Project-Based/Problem-Based Learning (PBL) method, where students work on comprehensive projects based on real-world problems or simulated scenarios. Students collaborate in small groups, allowing them to develop interpersonal skills, effective communication, and task delegation. Regular consultations with the teacher are held to monitor project progress, provide guidance on further work, and address any encountered challenges.

Bibliography

Basic:
Władyslaw Leśnikowski, Bezzałogowe platformy w cyberprzestrzeni, Toruń : Wydawnictwo Adam Marszałek, 2017
Dennis Roddy, Satellite Communications, McGraw-Hill, Inc. 2006

Additional:
Wojciech Giernacki, Drony i bezzałogowe statki powietrzne (UAV) : ku lotom autonomicznym grup latających robotów wielowirnikowych operujących w otoczeniu bliskim człowiekowi, Poznań : Wydawnictwo Politechniki Poznańskiej, 2018
Louis J. Ippolito, Satellite Communications Systems Engineering, John Wiley and Sons, Ltd. 2017
Gerard Maral, Michel Bousquet, Satellite Communications Systems, John Wiley and Sons, Ltd. 2012

Breakdown of average student's workload

	Hours	ECTS
Total workload	114	4,00
Classes requiring direct contact with the teacher	54	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,00