COURSE DESCRIPTION CARD - SYLLABUS

Course name
Telecommunications systems and services [N2AiR1-SW>PO2-SiUT]

Course

Field of study
Automatic Control and Robotics

Year/Semester
2/3

Area of study (specialization)
Vision Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
20

Laboratory classes
10

Other (e.g. online)
0

Tutorials
0

Projects/seminars
10

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Knowledge: A student starting this course should have knowledge of the basics of signal theory, signal and information processing, signal compression and coding and computer networks. Skills: A student should have the ability to use basic methods of signal processing and analysis in the time and frequency domain, digital signal coding (compression, encryption and redundant coding) and the ability to obtain information from the indicated sources. In addition, he or she should also understand the need to expand their competences and be ready to work together as a team. Social Competences: In addition, in terms of social competences, the student must show such qualities as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

1. To provide students with knowledge of techniques, system construction and design elements of modern telecommunications systems and services. 2. Developing students' skills in solving problems related to the selection of appropriate data transmission techniques with the use of ICT devices. 3. Drawing students' attention to the importance of knowing the standards and recommendations used in telecommunications systems.

Course-related learning outcomes

Knowledge
1. A student has specialist knowledge in the field of remote and distributed systems, real-time systems and network techniques - [K2_W3]
2. He or she understands the methodology of designing specialized analog and digital electronic systems - [K2_W4]
3. A student has knowledge of adaptation systems - [K2_W9]
Skills
1. A student is able to analyze and interpret the design technical documentation and use the scientific literature related to a given problem - [K2_U2]
2. He or she is able to use information and communication techniques - [K2_U8]
Social competences
A student is aware of the need for a professional approach to technical issues, scrupulous reading of the documentation and environmental conditions in which the devices and their components can function - [K2_K4]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Formative assessment:
a) in the scope of lectures: based on answers to questions about the material discussed in previous lectures,
b) in the scope of laboratory and design activities: based on the assessment of the current progress of the tasks implementation.
Summative assessment:
a) in the field of lectures, verification of the assumed learning outcomes is carried out by:
i. assessment of knowledge and skills demonstrated in the multiple-choice written test - 15 test questions, 1 point each and 3 design-problem tasks of 5 points. In total, the student can get 30 points. Rating scale: 0 ... 15 points - unsatisfactory, 16 ... 18 points - sufficient, 19 ... 21 points - sufficient plus, 22 ... 24 points - good, 25 ... 27 points - good plus, 28 ... 30 points - very good,
ii. discussion of test results,
b) in the field of laboratory classes, verification of the assumed learning outcomes is carried out by:
i. assessment of the student's preparation for individual laboratory classes ("entry" test) and assessment of skills related to the implementation of laboratory exercises
ii. evaluation of reports from the performed laboratory exercises
iii. grading scale for laboratory classes: 0 ... 10 points - unsatisfactory, 11 ... 12 points - sufficient, 13 ... 14 points - sufficient plus, 15 ... 16 points - good, 17 ... 18 points - good plus, 19 ... 20 points - very good,
c) in the field of project activities, verification of the assumed learning outcomes is carried out by:
i. assessment of knowledge and skills related to the implementation of project tasks
ii. evaluation and defense by the student reports on the implementation of the project.
Obtaining additional points for activity during classes, in particular for:
i. discuss additional aspects of the issue
ii. the ability to cooperate as part of a team practically carrying out a detailed task in the laboratory
iii. remarks related to the improvement of teaching materials
iv. identifying students' perceptual difficulties, enabling ongoing improvement of the teaching process.

Programme content

The lecture program includes the following topics:
1. Basic concepts in telecommunications: information sources, telecommunications channels,

representation of signals and systems, modulation, transmission codes, digital telecommunications system, telecommunications networks, measure of information, history of telecommunications.
2. Telecommunications traffic: traffic fluctuations, BHCA, types of traffic, report streams, systems with losses.
3. Continuous modulations (AM, FM, PM), frequency multiplication, noise in continuous modulations.
4. Digital modulations of sinusoidal carrier, ASK, FSK, PSK, DPSK, QAM, GMSK modulations, modulations with TCM trellis coding.
5. Speech codecs used in telecommunications systems: DPCM, DM, ADPCM, LPC, G.7xx standards.
6. Techniques of multiple access in telecommunications channels: FDMA, TDMA, CDMA.
7. Correction of errors during transmission; block, cyclic and convolutional codes.
8. Telephone networks: subscriber line set, tasks of the telephone exchange, types of signaling, signaling in the analog subscriber line, inter-exchange signaling, numbering, switching fields, examples of telephone exchanges.
9. Digital subscriber loop: integrated ISDN networks, DSL technologies, CATV access systems, fiber-optic access.
10. Wireless transmission: division of radio waves, parameters of terrestrial and satellite antennas, telecommunications law.
11. The concept of mobile telephony and the basics of its design; organization of radio channels; a mobile station and a set of base stations.
12. GSM cellular telephony: system architecture, switching and network part, speech coding, channel coding. Data transmission in the system and sending short messages.
13. 4G and 5G mobile technologies.
14. Communication modules (Bluetooth, ZigBee, WiFi) in automation solutions.
15. Global Positioning System (GPS).
16. Summary.
The program of laboratory classes includes the following issues:
1. AM modulation: generation of amplitude modulated signal, modulation depth coefficient, signal envelope, signal carrier, amplitude modulation of speech signal.
2. FM modulation: generation of phase modulated signal, modulation depth factor, signal carrier, phase modulation of speech signal, spectrum analysis of FM signal, FM signal bandwidth.
3. BPSK modulation: generation of BPSK signals, analysis of block diagrams of circuits for generating these signals, influence of noise on BPSK modulation and demodulation.
4. QPSK modulation: generation of QPSK signals, analysis of block diagrams of circuits for generation of these signals, comparison of QPSK modulation with BPSK, band analysis for transmitting BPSK and QPSK modulated signals.
5. Telecommunications encoders: PCM, AMR, EFR, G.723.1, G.729, iLBC; comparing the sound quality of coding and reproducing a sinusoidal signal, speech signal and music, calculating the SNR parameter for the obtained audio signals.
6. Streaming of audio-video signal: on demand streaming, live streaming, unicast addressing, multicast and broadcast, streamed in a local network using MPEG-2 and MPEG-4 standards, VLC support, use for streaming of TCP, UDP and RTP protocols, comparison of effects; analysis of the impact of computer network load on the quality of the streamed signal, assessment of the use of resources of computers transmitting and receiving the streamed signal.
The project activities program covers the following topics:
Analysis of selected transmission and data encoding standards in telecommunications systems, development of hardware implementations of selected transmission techniques and encoding algorithms used in telecommunications. IDE environments are used during the classes. Design classes are carried out by 2/3-person teams and take place in two stages:
1. Acquainting with Ethernet, XBee, Bluetooth, Wi-Fi, RFID modules, dedicated embedded microprocessor system.
2. Data transmission with the use of selected modules.

Teaching methods

1. Lecture: multimedia presentation
2. Laboratory classes: the use of Emona DATEx Telecoms-Trainer 202 modules, simulation tests in Matlab / Simulink environment, measuring equipment
3. Design classes: multimedia presentations, discussion, team work

Bibliography

Basic
1. Systemy telekomunikacyjne, cz.1 i 2, Haykin S., Wydawnictwa Komunikacji i Łączności, Warszawa, 2004
2. Sieci telekomunikacyjne, Kabaciński W., Żal M., Wydawnictwa Komunikacji i Łączności, Warszawa, 2008
3. Podstawy cyfrowych systemów telekomunikacyjnych, Wesołowski K., Wydawnictwa Komunikacji i Łączności, Warszawa, 2003
4. Systemy radiokomunikacji ruchomej, Wesołowski K., Wydawnictwa Komunikacji i Łączności, Warszawa, 2003
Additional
1. Telekomunikacja, cz.1 i 2, Jackowski S., Politechnika Radomska, Radom, 2003
2. Emona DATEx lab manual Vol. 1 -experiments in modern analog & digital telecommunications, Duncan B., Emona Instruments
3. Fale i anteny, Szóstka J., Wydawnictwa Komunikacji i Łączności, Warszawa, 2006

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	40	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,50