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## TEACHING OF DISCIPLINE "SYSTEMS OF AVIATION TELECOMMUNICATIONS" IN ENGLISH

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*The teaching technique of discipline "Systems of aviation telecommunications" is presented. The content of modules and the list of laboratory works is given. Laboratory works are connected with computer modeling in Mathcad and MATLAB Simulink environments.*

*Розглянуто методику викладання дисципліни «Системи авіаційного електрозв'язку» англійською мовою. Наведено зміст модулів та перелік лабораторних робіт, пов'язаних із моделюванням на комп'ютерах в середовищах Mathcad та MATLAB Simulink.*

*Рассмотрена методика преподавания дисциплины «Системы авиационной электросвязи» на английском языке. Приведено содержание модулей и перечня лабораторных работ, связанных с моделированием на компьютерах в средах Mathcad и MATLAB Simulink.*

### Introduction

The discipline "Systems of Aviation Telecommunications" belongs to the branch 6.070102 "Air Navigation" and is intended for students of a third year. The discipline is read in the fifth and sixth semester and contains 343 hours (lectures – 87, laboratory works – 52, individual work – 10, self study – 193, term paper - 6 semester, exams – 5, 6 semester). Syllabus of this discipline is based on "Provisional Regulations on Training according to ECTS (within the pedagogical experiment)" and "Provisional Regulations on the Assessment Grading System" approved by the Rector of the University in 2004.

### Analysis of researches

Publications devoted to teaching of this discipline in English in the literature are absent. Therefore especially important are questions connected with the correct organization of educational process [1–3]. One of the necessary conditions for the organization of educational process in accordance with credit-modular system is availability of the working curriculum for the discipline. The evaluation rating system is the integral part of working curriculum, which allows determining the quality of

student's study. Received points are transformed into traditional national scale and European Credit Transfer System (ECTS) scale.

**The aim** of this article is to present teaching technique of discipline "System of aviation telecommunications" and to give the content of modules and the list of laboratory works.

### Purpose of the discipline teaching

The target of the discipline teaching consists in disclosing of modern scientific concepts, methods and technologies of aviation and satellite communication systems design.

Tasks for learning the discipline:

- studying of physical bases for telecommunications systems design for continuous and discrete messages transmission;
- studying of modulation principles, coding, compression of continuous and digital signals and multistation access methods;
- studying of broadband noise-like signals transmission and receiving;
- research of construction principles for aviation telecommunications systems and Aeronautical Telecommunication Network (ATN) data transmission network;
- research of construction principles for general purpose telecommunications systems and cellular and satellite communication systems;

- mastering by methods and operation processes of surveillance systems;
- mastering by research methods and technologies for mathematical modeling of communication systems on an example of calls streams in multichannel systems;
- mastering by methods and technologies of mathematical modeling for satellite communication lines;
- research of functioning algorithms for modern space communication systems and networks.

Discipline status in the system of professional training consists in that this discipline is a theoretical basis of knowledge and abilities, which form an aviation profile of the expert in the field of air navigation.

The knowledge and the abilities received during studying of the given discipline, will be used during studying of the overwhelming majority of following disciplines.

### **Discipline content**

The topical plan of the discipline "Systems of Aviation Telecommunications" is the following.

Module 1. Theoretical fundamentals of aviation telecommunications.

1.1. The organization and structure of aviation telecommunications.

1.2. The general principles of aviation telecommunications systems design.

1.3. Analogue signals transmission.

1.4. Discrete signals transmission.

1.5. Noise-resistant coding.

1.6. Pulse telecommunications systems.

1.7. Transmission of continuous messages in digital telecommunications systems.

1.8. Encryption of messages.

1.9. Elements of queuing systems. Characteristics and kinds of calls streams.

1.10. Module control work №1.

Module 2. Aviation telecommunications systems.

2.1. Broadband telecommunications systems.

2.2. Methods of processing and synchronization for broadband signals.

2.3. Multichannel systems and asynchronous address telecommunications systems.

2.4. Characteristics of airborne and ground telecommunications antennas.

2.5. Aviation direct visibility systems of air and ground telecommunications.

2.6. HF aviation telecommunications systems.

2.7. Troposphere and meteor telecommunications systems.

2.8. Radio relay systems.

2.9. Aviation satellite telecommunications systems.

2.10. Power indicators and satellite transmission lines.

2.11. Multistation access of satellite telecommunications.

2.12. Satellite telecommunications equipment.

2.13. Module control work №2.

Module 3. Data transmission systems.

3.1. Discrete data transmission systems. Transmission systems without feedback.

3.2. Transmission systems with feedback.

3.3. Data transmission networks.

3.4. Public data transmission networks with package commutation.

3.5. Transport networks of data transmission.

3.6. Construction principles of cellular telecommunications networks.

3.7. Construction concept of cellular telecommunications networks 4G.

3.8. Perspective cellular telecommunications radio interfaces on the base of Code Division Multiple Access (CDMA) technology.

3.9. Module control work № 3.

Module 4. Aviation telecommunications network and airborne communication complexes.

4.1. Aviation telecommunications network construction principles.

4.2. Construction principles for Very High Frequency Data Link (VDL) data transmission lines.

4.3. Construction principles for High Frequency Data Link (HFDL) data transmission lines.

4.4. Aviation mobile satellite service.

4.5. Airborne aviation radio stations.

4.6. Receiving tract of aviation radio station.

4.7. Transmission tract of aviation radio station.

4.8. Frequency synthesizers and control systems.

4.9. Module control work № 4.

Module 5. Term paper.

5.1. Calculation of power for a satellite line on the basis of its mathematical model, characteristics of retranslators and ground stations of a satellite communication.

At studying of discipline students perform the following laboratory works.

Module 1. Theoretical fundamentals of aviation telecommunications.

1.1. The spectral analysis of periodic oscillations.

1.2. The spectral analysis of aperiodic oscillations.

1.3. Computer models of signals with analogue kinds of modulation Amplitude Modulation (AM), Single Sideband Modulation (SSB), Frequency Modulation (FM), Phase Modulation (PM).

1.4. Modelling of signals with discrete kinds of manipulation Phase Modulation (ASK), Frequency Shift Keying (FSK).

1.5. Modelling of signals with phase manipulated and quadrature modulation kinds Phase Shift Keying (PSK), Quadrature Amplitude Modulation (QAM).

1.6. Modelling of signals with pulse modulation Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM).

1.7. Modelling of signals with modulation by MSK method.

1.8. Modelling on CC the elementary stream of calls and quality of work for automatic telephone station

Module 2. Aviation telecommunications systems.

2.1. Modelling of broadband signals by interpulse linear-frequency modulation and phase code modulation.

2.2. Modelling of random radio signals with analogue and discrete modulation.

2.3. Modeling of demanded antenna characteristics for satellite communication.

2.4. Modeling of satellite data transmission line parameters using computer aided design systems. Service area. Zones. Geometric characteristics of satellite location.

2.5. Modeling of satellite data transmission line parameters using computer aided design systems. Energy indicators of satellite transmission line. Signal losses on path.

2.6. Investigation of operational principle and technical characteristics for satellite communication terminal Inmarsat mini-M and program complex Amos Connect.

2.7. Investigation of characteristics for dipole and aperture communication antenna.

2.8. Investigation of characteristics for phased antenna array.

Module 3. Data transmission systems.

3.1. Modeling of quantization methods for continuous signals and signals with pulse-code modulation and delta modulation.

3.2. Modeling of signals transformations with discrete modulation in receiving channel.

3.3. Research of protocols and the comparative analysis of radio interface characteristics on the CDMA and Orthogonal Frequency-Division Multiplexing (OFDM) basis.

3.4. Research of function schemes and a principle of operation for airborne aviation VHF radio station.

Module 4. Aviation telecommunications network and airborne communication complexes.

4.1. Research of construction, functional design and operational principle for airborne aviation radio station Very High Frequency (VHF) Orlan 85 ST, VHF-4000.

4.2. Modeling of analogue signals passing through oscillatory circuit.

4.3. Modeling of discrete signals (On Off Keying (OOK), FSK, PSK) passing through oscillatory circuit.

4.4. Modeling of receiving channel stability for discrete signals with hindrances.

Term paper is creative or reproductive solving of a specific task, as a rule having a research character, which is carried out in 6 semestre according to the approved methodical recommendations. The purpose of course work is deepening of theoretical knowledge and the abilities got by the student, especially in the field of a satellite telecommunications. Term paper topics must be approved on faculty meeting.

Performance of term paper is the important stage in preparation for future degree project in the field of aeronavigation service systems.

Specific goal of term paper is connected with calculation of satellite line energy characteristics on the basis of its mathematical model, retranslators parameters and ground stations of a satellite communication.

For successful performance of term paper the student should know features of fixed satellite telecommunications systems, basic characteristics of satellites on a geostationary orbits, characteristics of antennas and propagation conditions of radio-waves, methods of multiple access, methods of signals modulation and mathematical modelling technology of dynamic systems, requirements of standard and regulating documents, be able to develop independently program models on PC, to carry out research of a satellite line with the help of computer program models.

Performance, preparation and defense of term paper are carried out by the student individually according to methodical recommendations.

Necessary time for performance of term work – is up to 36 hours of independent work.

### Features of teaching

Along with usual language problems there are the difficulties connected with specific terminology and abbreviations. Considering complexity of new material perception by students even on the native language it is impossible to teach this discipline in English using the traditional way, namely, orally explaining material and writing down on a board necessary formulas. After 10-15 minutes of such lecturing students cease to perceive a material (as it demands constant special attention and serious mental work), lose interest, time is used unproductively and as a result lecture does not reach its purpose.

Our experience of lecturing for students of a third year has shown that for qualitative mastering of a material it is necessary for student to see the text, to have possibility to return to the previous material and to ask questions.

It has been reached as a result of using together with traditional lecturing the Power Point presentations consisting approximately from 60-70 slides for each lecture. In total in a course for 38 lectures it has been created more than 2500 slides with outlining of the basic definitions and terms in text by different colors, animations, colorful illustrations and necessary schemes. As a result, on the one hand, the perception of a material was easier due to the connection of audio and visual channels of information receiving, and, on the other hand, it was possible to keep attention of students throughout all lectures. Knowing, that at the end of a lecture everyone can copy the presentation of a lecture and work with it at home, students ask questions at lecture more actively.

Material mastering was promoted by creation of a unique cycle from 24 laboratory works in English. All laboratory works are connected with computer modeling in Mathcad and MATLAB Simulink environments. Reports on laboratory works and "defense" of works students did in English.

Students also carried out modular examinations and term paper in English.

### Conclusion

Discipline «Systems of Aviation Telecommunications» teaching in English gives possibility on student's bench to master modern world-wide used terminology and raises competitiveness our students on a labor market.

### References

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