The syllabus of the discipline

Data processing technologies in infocommunications

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Field name	Detailed content, comments
Name of the faculty	Faculty of Infocommunications
Level of higher education	First (bachelor's)
Code and name of the specialty	172 Telecommunications and radio engineering
Type and name of educational program	EPP "Information and Network Engineering"
Name of the discipline	Data processing technologies in infocommunications
Number of ECTS credits	3
Discipline structure (distribution by types and hours of study)	20 hours - 10 lectures, 16 hours - 4 laboratory classes, 6 hours - 3 consultations, 48 hours - homework, **type of control**: credit
Schedule (terms) of studying the discipline	2nd year, III semester
Prerequisites for studying the discipline	Basic knowledge of disciplines that provide knowledge: 1. Information systems and technologies, 2. Digital signal processing 3. Local area networks 4. Fundamentals of information and communication technologies
Competences, knowledge, skills, understanding, which is acquired by the applicant in higher education in the learning process	The discipline is used for formation the following competencies: to have knowledge of the theory and methods of basic and general engineering sciences the amount needed to solve specialized problems and practical problems in the field of professional activity.
The quality of the educational process	Educational-methodical and material-technical resource provision of the educational program, within the framework of which the discipline is studied, meets the licensing requirements and accreditation conditions of the educational activity of the university. Annual monitoring and revision of the curriculum of the discipline in accordance with the requirements and recommendations of the Ministry of Education and Science, state certification of acquired competencies of graduates, standards of cooperation with employers to ensure a competitive level of training. Adherence to the principles of academic integrity (https://lib.nure.ua/plagiat). Contains public information on the requirements, competencies, level of education within the current educational program

Description and content of the discipline

The purpose of the discipline is to provide students with knowledge, skills and abilities in the field of data processing technologies in infocommunications, methods of theoretical and experimental development and research of mathematical models of random processes, application of new scientific and technical solutions.

The course examines: modern methods of analysis and processing of random processes and signals in infocommunications, classification of random processes and signals, analysis of economic and exchange data, correlation analysis, spectral analysis methods, analysis of random signals and chains in time and frequency space, theory of random parameters of processes, pair regression analysis, multiple regression analysis, models of linear prediction of stationary random processes, autoregression model, modeling of narrowband random signals, autoregression model-integrated moving average of nonstationary random processes, lattice filter synthesis, parametric forecasting, parametric random processes of higher orders.

Content

Content module 1. Modern methods of analysis and processing of random processes and signals in infocommunications

Topic 1. General definitions, methods of description, classification of random processes and signals.

Discrete random process. Mathematical models. Stationary and non-stationary, Gaussian and non-Gaussian, ergodic and non-ergodic processes. Central limit theorem.

Topic 2. The role of infocommunications in the activities of world exchanges.

General information about world exchanges. The importance of the stock exchange in the development of the world economy. Analysis of economic and exchange data.

Topic 3. Correlation theory.

Correlation analysis. Correlation function. Correlation matrix and its inversion. Mutual correlation. Examples of application of correlation analysis.

Topic 4. Spectral analysis.

Methods of spectral analysis. Analysis of random signals and circuits in time and frequency space. Connection with correlation theory.

Topic 5. Regression models of random processes.

Pairwise regression analysis. Multiple regression analysis.

Content module 2. Models of random processes

Topic 1. Models of linear prediction of stationary random processes. Autoregression model

Theoretical foundations of linear prediction models. Construction of the model of autoregression, moving average, autoregression-moving average. Parametric spectral analysis. Synthesis of random signal processing devices using autoregression model.

Topic 2. Modeling of random processes with given characteristics

General information about simulation. Simulation of narrowband random signals. Spectral analysis of generated signals.

Topic 3.Models of linear prediction of nonstationary random processes

Autoregression-integrated moving average model. Model of linear prediction of seasonal

random processes. Identification of linear prediction models.

Topic 4. Prediction of random processes based on a nonstationary model of autoregression-integrated moving average

Parametric forecasting according to the autoregression-integrated moving average model. Forecasting the intensity of negotiations in the mobile communication system.

Topic 5. Lattice filters for data processing. Language compression in mobile communication

Levinson-Darbin algorithm. Synthesis of lattice filter. Generation of random processes using lattice filters. Examples of processing of stationary random processes by means of lattice filters.

Learning outcomes of higher education

As a result of studying the discipline, students must:

- know: basics of data processing technologies in infocommunications, methods of analysis of random signals and circuits in time and frequency space, basics of simulation of random signals, methods of theoretical and experimental data research, analysis of non-Gaussian random processes using higher order statistics.

- be able to: calculate and analyze the statistical characteristics of random processes, develop devices for processing information signals using their statistical models.

Assessment system according to each task for passing the test / exam

To evaluate the student's work during the semester, the final rating score of Q_{sem} is calculated as the sum of grades for different types of classes and control activities.

Each practical lesson is evaluated in 6 points (1 point for attendance and 5 points for work in the class). Each laboratory work is estimated at 6 points (1 point for attendance, 1 point for practice, 4 points for defense). Auditory blank test - 14 points. Individual homework (ID) - 41 points. The maximum rating during the semester is 100 points.

Type of lesson / control measure	Rating
Lc № 1, 2, 3, 4	1x4=4
Pr № 1, 2, 3	6x3=18
Test № 1	14
Control point № 1	**36**
Lc № 5,6, 7, 8, 9	1x5=5
Pr № 3, 4,5	6x3=18
Individual homework	41
Control point № 2	**64**
Total for the semester	**100**

As a form of final control in the discipline is used offset. At this type of control is the final assessment of P_P calculated by the formula:

$$P_P = 0.6Qsem + 0.4Qisp,$$

where Qsem - assessment for the semester on a 100-point scale, Qisp - score for the test on a 100-point system.

Qualitative evaluation criteria in the national scale and ECTS

Satisfactory, D, E (60-74). Show the required minimum of theoretical knowledge. Know the ways and methods of solving practical problems and be able to use them in practice.

Well, C (75-89). Firmly know a minimum of theoretical knowledge. Demonstrate the ability to solve a practical problem and justify all stages of the proposed solution.

Excellent, A, B (90-100). Show complete knowledge of basic and additional theoretical material. Unmistakably solve a practical problem, explain and justify the chosen method of solution. Criteria for assessing the knowledge and skills of the student in the combined exam.

Assessment scale: national and ECTS

The sum of points for all types of educational activities	ECTS assessment	Score on a national scale	
		for exam, course project (work), practice	for offset
90 – 100	**A**	perfectly	credited
82-89	**B**	fine	
74-81	**C**		
64-73	**D**	satisfactorily	
60-63	**E**		
35-59	**FX**	unsatisfactory with the possibility of reassembly	not credited with the possibility of re-assembly
0-34	**F**	unsatisfactory with mandatory re-examination	not credited with compulsory re-study of the discipline

Methodical support

Basic literature

1. Tykhonov V.Y. Statystycheskaia radyotekhnyka. – M.: Radyo y sviaz, 1982. – 624 s.
2. Boks Dzh., Dzhenkyns H. Analyz vremennykh riadov: Per. s. anhl. – M.: Myr, 1974. – Vyp.1. – 406s.
3. Marpl.–ml. S. L. Tsyfrovoi spektralnyi analyz y eho prylozhenyia. – M.: Myr, 1990. – 584 s.
4. Bendat D., Pyrsol A. Prykladnoi analyz sluchainykh dannykh. – M.: Myr, 1989. – 540 s.
5. Serhyenko A.B. Tsyfrovaia obrabotka syhnalov: ucheb. posobye. – SPb.: BKhV- Peterburh, 2011.-768.
6. Tykhonov V.A., Rusanovskyi D.E., Tykhonov D.V. Heneryrovanye uzkopolosnykh ymytatsyonnykh sluchainykh protsessov // Radyoelektronyka y ynformatyka. – 1999. – №4. – S. 83–85.
7. Karmalyta V.A. Tsyfrovaia obrabotka sluchainykh kolebanyi. – M: Mashynostroenye, 1986.– 80s.

Supporting literature

1. Bykov V.V. Tsyfrovoe modelyrovanye v statystycheskoi radyotekhnyke. – M.: Sov. Radyo, 1971. – 326 s.
2. Omelchenko V.O., Bezruk V.M., Drahan Ya.P., Kolesnykov O.O., Omelchenko A.V. Imovirnisni modeli vypadkovykh syhnaliv ta poliv prykladakh ta zadchakh: Navch. posibnyk / Za red. V.O. Omelchenka.–K.:ISDO, 1996.– 272s.
3. Boks Dzh., Dzhenkyns H. Analyz vremennykh riadov: Per. s. anhl. – M.: Myr, 1974. – Vyp.2. – 197 s.
4. Hreshylov A.A., Stakun V.A., Stakun A.A. Matematycheskye metody postroenyia prohnozov. – M.: Radyo y sviaz. 1997.–112 s.
5. Tiuryn Yu.N., Makarov A.A. Statystycheskyi analyz dannykh na kompiutere. / Pod red. V.E. Fyhurnova.–M.: YNFRA–M. 1998. 528 s.

Methodical instructions for different classes

1. Metodychni vkazivky do laboratornykh robit z dystsypliny "Mobilni systemy radiozviazku" dlia studentiv usikh form navchannia spetsialnosti 7.090703 "Aparatura radiozviazku, radiomovlennia i telebachennia"/U poriad.: I.V.Savchenko, V.A Tykhonov. Kharkiv: KhIIURE. 2011- 48 c.

Internet sources

1. http://www.mathworks.com/products/matlab/ - MATLAB. The Language of Technical Computing.
2. http://www.chemometrics.ru/materials/textbooks/matlab.htm - MatLab. Rukovodstvo dlia nachynaiushchykh.
3. http://algolist.manual.ru/compress/standard/ - Obshchye alhorytmy czhatyiy kodyrovanyia.
4. http://matlab.exponenta.ru/ml/book1/index.php -Vvedenye v Matlab.
5. http://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring2011/ - Digital Signal Processing

Information support

MATLAB Portable software package.