National Technical University of Ukraine
«IGOR SIKORSKY
KYIV POLYTECHNIC INSTITUTE»

Department of Applied Radioelectronics

[TS-07] SIMULATION MODELING IN TELECOMMUNICATIONS AND RADIOENGINEERING

Work program of the discipline (Syllabus)

Details of the discipline

Level of higher education	Third (educational and scientific)
Field of knowledge	17 - Electronics and telecommunications
Specialty	Telecommunications and radioengineering
Educational program	Telecommunications and radioengineering (2020-06-30)
Discipline status	Normative
Form of study	Full-time
Year of study, semester	2nd year, spring semester
Scope of discipline	3 cred. (lect. 18 h., pract. 18 h.)
Semester control	exam
Lessons schedule	https://rozklad.kpi.ua
Language of teaching	Ukrainian / English
Information about the course leader / teachers	Lect.: prof. Nelin E. A., Pract.: prof. Nelin E. A.
Course placement	

Program of educational discipline

1. Description of the discipline, its purpose, subject of study and learning outcomes

The purpose of the discipline — the formation of graduate students' competencies in the field of simulation of telecommunications and radioengineering processes, devices and systems and methods of computer research of typical wave structures.

The subject of the discipline — the technology of simulation modeling, critical analysis of modeling results.

Program learning outcomes

Competences:

(ZK 1) ability to critically analyze, evaluate and synthesize new complex ideas;
(FK 2) ability to apply mathematical methods of scientific research, simulation modeling, applied aspects of systems analysis in various types of professional activities;
(FK 3) ability to perform theoretical and experimental research, mathematical and computer modeling of processes in telecommunications and radio systems and devices.

Knowledge:

(ZN 4) modern mathematical methods of scientific research, simulation modeling, applied aspects of systems analysis.

Skills:

(UM 5) perform individual research activities in the field of telecommunications and radioengineering using modern mathematical methods of research, simulation, applied aspects of systems analysis;
(UM 7) plan, organize work and manage projects in the field of research, development, analysis, calculation, modeling, production and testing of telecommunications and radiosystems and devices;
(UM 11) substantiate and analyze the choice of a specific type of model and method of telecommunication and radio systems in solving relevant practical problems.

After mastering the material of the discipline, graduate students will gain fundamental knowledge in the field of theory and practice of simulation in telecommunications and radioengineering, practical knowledge of simulation modeling on the examples of typical objects of telecommunications and radioengineering; acquire the ability to apply the acquired knowledge in the development of new scientific methods and in the latest industrial technologies and samples of new technology, to explain the data and predict new scientific results; gain experience in the practical application of simulation methods for telecommunications and radioengineering; conducting research and summarizing their results in the field of wave phenomena, wave structures and wave signal processing devices; individual work with educational, scientific and reference literature.

2. Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of education according to the relevant educational program)

To successfully master the discipline, the graduate student must have a "Foreign language for research", as much of the latest technology is taught in English.
Competences, knowledge, skills and experience gained in the process of studying the credit module are necessary for research on the topic of the dissertation.

3. The content of the discipline

The discipline is structurally divided into 4 chapters:

Chapter 1. Basic concepts of modeling theory

Chapter 2. Technology of simulation modeling. Processing of simulation results

Chapter 3. Simulation modeling of physical processes, systems and devices of telecommunications and radioengineering.

Chapter 4. Simulation modeling of structures and devices of wave radioelectronics

4. Training materials and resources

Basic literature:
1. Law A. M. Simulation Modeling and Analysis, 5 th ed. – NJ: McGraw-Hill Education, 2015. – 776 p.
2. Zelensky K.H., Kit G.V., Chumachenko O.I. Computer modeling of systems. - Kyiv: University "Ukraine", 2014. - 315 p.
3. Anu M. Introduction to modeling and simulation. Proceedings of the 29th conference on Winter simulation, December 1997, pp. 7–13.
4. Stepashko V. Modeling as the basis of intelligent technologies and systems. – http://irtc.org.ua/image/app/webroot/Files/presentations/МНУЦ/Отдел_Степашко/Stepashko_IntMod-25-4-2017.pdf
Auxiliary sources:
5. Shannon R. Simulation modeling of systems - art and science. - M .: Mir, 1978. - 418 p.
6. Ryzhikov Yu. I. Simulation modeling, Theory and technology. - SPb: Korona Print, 2015. - 380 p.
7. Markos P., Soukoulis C. M. Wave Propagation: From Electrons to Photonic Crystals and Left-Handed Materials. – Princeton and Oxford: Princeton Uuniversity Press, 2008. – 352 p.

Educational content

5. Methods of mastering the discipline (educational component)

Lectures. List of main issues

Chapter 1 Basic concepts of modeling theory

1.1 Scientific modeling as a method of studying objects of knowledge

1.2 Modeling process

1.3 Elements of system analysis. Classification of systems

1.4Types of modeling

1.5 Types of simulation modeling

Chapter 2 Simulation technology. Processing of simulation results

2.1 Implementation of simulation modeling

2.2 Computer simulation and its limitations

2.3 Processing of simulation results

2.4 Analysis of simulation results

Chapter 3 Simulation of physical processes, systems and devices of telecommunications and radioengineering

3.1 Features of simulation modeling in telecommunications and radioengineering

3.2 Simulation modeling of basic physical processes of radio electronics

3.3 Simulation modeling of lumped and distributed electronic systems

3.4 Features of simulation modeling of telecommunications and radioengineering devices

Chapter 4 Simulation modeling of the structure and devices of wave electronics, reliability of telecommunication and radio systems

4.1 Modeling of single wave structures

4.2 Modeling of resonant wave structures

4.3 Modeling of periodic wave structures

4.4 Modeling of wave radioelectronics devices

4.5 Simulation of reliability of software and telecommunication and radiosystems

Topics of practical classes. Tasks are performed by computer simulation in a computer class.

1 Simulation modeling of distributed electronic systems on the example of single barrier wave structures

2 Simulation modeling of quantum-mechanical single barrier structures

3 Simulation modeling of resonant two-barrier structures

4 Simulation of multi-barrier structures

5 Software reliability research

6 Simulation of reliability of telecommunication and radioengineering systems

6. Individual student work

In order to improve the quality of learning material and experience of theoretical research, individual tasks are provided in the form of calculation and graphic work on the subject of the discipline.

Policy and control

7. Policy of academic discipline (educational component)

The system of requirements for graduate students:

Attendance at lectures and practical classes is a mandatory part of studying the material;

- at the lecture the teacher uses his own presentation material; uses Google drive and distance learning platform "Sikorsky" to teach the material of the current lecture, additional information, tasks for practical work and more;
- questions at the lecture are allowed to be asked during the lecture;
- to protect practical work it is necessary to perform the tasks provided for in it and make analytical conclusions;
- incentive points are set for: independent original solution of problems of practical classes. Number of penalty points not more than 10;

Penalty points are awarded for late performance of practical classes. Number of penalty points not more than 10.

8. Types of control and rating system for evaluation of learning outcomes (RSE)

The graduate student's rating consists of points for:

1) work on lectures;
2) work in practical classes;
3) performance of tasks of practical works;
4) answers to the exam;
5) incentive and penalty points.

Estimated work:

Weight score of calculation work = 10 with the following evaluation criteria:

5 - 7 points - the work contains some significant errors, but does not require complete revision (credited);
8 - 10 points - the work is done correctly, has no significant defects and comments (credited).

Practical tasks:
The total weight score for practical classes during the semester is 40 points with the following evaluation criteria:

6 points - satisfactory performance of the task;
8 points - good performance of the task;
10 points - excellent performance.

Incentive points
for active work in lectures and practical classes, but in the amount of not more than 10.

Rating scale in the discipline RD = 100 points and is formed from the total weight score for work in the semester (starting rating) RC and the examination component of RE:

$$RD = RC + RE$$

As stated in the previous paragraphs

$$RC = Rpr + Rcw = 50 \text{ points} + (Ri - Rp)$$

where *Rpr* – score for a practical task (0…40);

1. *Rcw* – score for a practical task (6…10);
2. *Ri* – incentive points (0…10);
3. *Rp* – penalty points (0…10).

The examination component is 50% rating scale and is *RE* = 50 points. Exam assessment system:

1) answers to all tasks of the examination ticket are absent or contain gross errors and do not meet the minimum required level of mastering the material 0 - 9 points;
2) given generally correct answers not less than 25% of ticket tasks 10 - 19 points;
3) generally given correct answers not less than 50% of ticket tasks 20 - 29 points;
4) given correct answers not less than 75% of ticket tasks 30 - 39 points;
5) comprehensive and reasoned answers to all tasks of the ticket 40 - 50 points

Conditions for admission to the exam: a student is admitted to the exam if he: has a starting rating RC> 0.5 RC, ie RC> 25 points; has credited calculation and practical work.

The sum of the earned RD points or points for credit work is transferred to the credit score according to the table:

Number of points	**Score**
100-95	Excellent
94-85	Very good
84-75	Good
74-65	Satisfactory
64-60	Enough
Less than 60	Unsatisfactory
Not allowed conditions of admission	Not allowed

Work program of the discipline (syllabus):

Compiled by prof. Nelin EA;

Approved by the department of EA (protocol № EA, №6, 21.06.2021)

Approved by the methodical commission of the faculty (protocol № 06-2021, 29.06.2021)