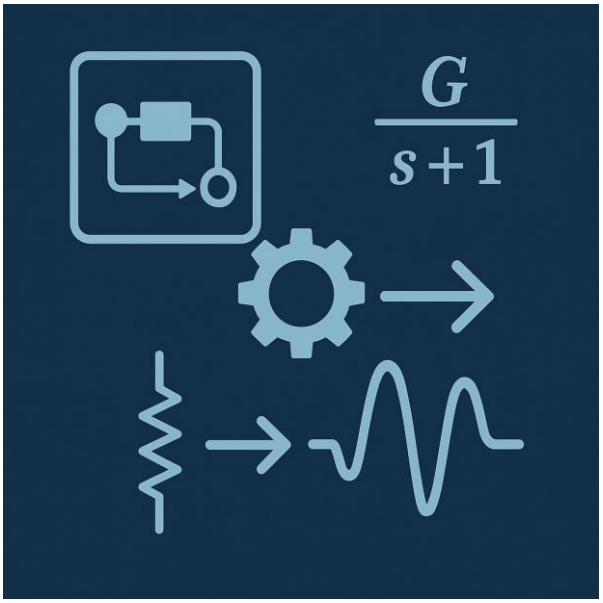
Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Department of Applied Radio Electronics

[RE-5] RADIO AUTOMATION



Work program of the academic discipline (Syllabus)

Course details

Level of higher education	First (bachelor's)
Field of knowledge	17 - Electronics, Automation, and Electronic Communications
Specialization	172 - Electronic Communications and Radio Engineering
Educational program	All educational programs
Discipline status	Elective (F-catalog)
Form of higher education	Full-time
Year of training, semester	Available for selection starting from the 3rd year, fall semester
Scope of the discipline	4 credits (Lectures 18 hours, Practical classes 36 hours, Laboratory work 36 hours, Independent work 66 hours)
Semester Control/control measures	Credit
Class schedule	https://schedule.kpi.ua
Language of instruction	Ukrainian
Information about the course coordinator/teachers	Lecturer: N. O. Laschevska, Lab: S. O. Sokolsky,

Course placement https://do.ipo.kpi.ua/course/view.php?id=2452

Curriculum

1. Description of the course, its purpose, subject matter, and learning outcomes

Modern radio engineering devices for various purposes and radio control systems use automatic systems called radio automation systems (**RA systems**). Such systems include frequency and phase auto-tuning systems, automatic gain control, distance measurement, various tracking filters, systems for measuring the coordinates of moving objects, etc.

The theory of automatic regulation and automatic control is an integral part of the design of complex dynamic systems. The goal of automation is to free people and directly involve them in the process of managing and regulating automation tasks: 1. building the best systems in terms of control quality is a task of synthesis; 2. theoretical research is a task of analysis;

Radio automation *is the science of the general principles and methods of building automatic control systems in radio engineering and radio electronics, i.e., systems that perform the tasks assigned to them without the direct participation of a person (operator).*

Nowadays, RA systems based on the latest achievements in microelectronics and microprocessor technology are very common in radio control systems.

The knowledge gained by students in the course of studying the discipline "Radio Automation" will be useful in studying the following disciplines of the curriculum for training specialists in the field of radio engineering and radio communications.

As a result of studying the discipline**,** students should **KNOW:**

- the basic principles of automatic control theory and its application in the construction of radio-automatic control systems; - typical radio-automatic systems and the principles of their operation; - basic mathematical methods of analysis and synthesis of linear automatic control systems, methods of testing systems for stability, basics of radio-automatic system optimization; - typical transfer functions and typical dynamic links of radio-automatic systems, basics of building and transforming structural diagrams; - basic elements of radio-automatic systems and their characteristics;

BE ABLE TO:

- calculate the transfer functions of radio automation system elements and the system as a whole;
- evaluate the stability of the system in operation; - design automatic control systems for radio devices.

SKILLS:

- construct structural, functional, and schematic electrical diagrams of radio automation systems and their circuit implementation; - perform mathematical modeling using modern computer software for automatic control systems and determine their characteristics and parameters.

2. Prerequisites and post-requisites of the discipline (place in the structural-logical scheme of training under the relevant educational program)

The discipline "Radio Automation" is based on the courses "Fundamentals of Circuit Theory," "Processes in Linear Electronic Circuits," "Fundamentals of Telecommunications Theory," and "Higher Mathematics." To study "Radio Automation," it is desirable for students to have taken and mastered these basic disciplines. Also, to perform laboratory work in "Radio Automation," students must be familiar with the methods of modeling in the MatLab environment, which are taught in the course "Computer Science."

3. Contents of the academic discipline

Topic 1. General characteristics of automatic systems
Topic 2. Transfer function of radio automation systems
Topic 3.Typical links of radio automation systems
Topic 4. Stability of automatic systems

Topic 5. Assessment of the quality of automatic systems in transient mode

Topic 6. Accuracy of automatic systems under typical influences

4. Teaching materials and resources

1. Theory of automatic control: [textbook] / [Zaitsev G.F. et al.]. - Kyiv: Tekhnika, 2002. - 688 p.

2. Burova T.V. Handbook of Radio Automation / Burova T.V., Gradoboeva N.V., Zakharchenko M.V..- Kyiv: Technika, 1992. – 440 p.

Educational content

5. Methodology for mastering the academic discipline (educational component)

LECTURE 1 Introduction Subject and objectives of the course. A brief history of the development of automatic control systems. 1.1. Basic concepts and definitions. 1.2. Functional diagram of a closed automatic system. 1.3. Classification of automatic systems.

LECTURE 2 Generalized functional and structural diagrams of a radio tracking system. Rules for converting structural diagrams.

LECTURE 3 Transfer functions of a closed system. Tracking system as a filter

LECTURE 4 Mathematical methods for describing typical links. Non-inertial (amplifying, proportional) link. Inertial link (first-order aperiodic link). Integrating link

LECTURE 5 Excitation link. Oscillatory link.

LECTURE 6 General requirements for the stability of automatic systems. Algebraic stability criteria.

LECTURE 7 Frequency criteria for the stability of RA systems. Stability margin of RA systems.

LECTURE 8 Main quality indicators of ACS. Direct and indirect methods of assessing the quality of the transition process. Types of transition processes

LECTURE 9 Static and dynamic errors of typical automatic control systems. Static error for typical automatic control systems (static, astatic of the first and second orders). Astatic automatic control systems. Determination of dynamic errors (by speed, by acceleration) for static and astatic systems.

Laboratory work No. 1 Investigation of the reactions of typical links to various types of influence

Laboratory work No. 2 Investigation of the dynamic characteristics of typical links Laboratory work No.

3 Frequency characteristics of dynamic links

Laboratory work No. 4 Investigation of the quality of control processes in a static system

6. Independent work of the student

Students must prepare in advance for laboratory work and independent work based on lecture materials. Before lectures, it is necessary to review the theoretical material provided in previous lectures. Before laboratory classes, it is necessary to review the relevant theoretical material.

Policy and control

7. Policy of the academic discipline (educational component)

Attendance at laboratory classes is mandatory. Students actively participate in class work. For objective reasons (e.g., prolonged illness, international internship), training may take place online in agreement with the course instructor. It is also possible to make up for missed classes during consultation hours.

All materials of laboratory work reports and MCRs submitted by applicants are checked for academic integrity.

8. Types of control and rating system for assessing learning outcomes

44 points for modular control work - 1 MCR*44 points=44 points;

14 points for completing a laboratory assignment = 4 assignments*14 points=56 points.

Table of correspondence between rating points and grades on the university scale

Number of points	Grade
100-95	Excellent
94	Very good
84	Good
74-65	Satisfactory
64-60	Sufficient
Less than 60	Unsatisfactory
Admission requirements not met	Not admitted

9. Additional information on the discipline (educational component)

Description of material, technical, and informational support for the discipline

Laboratory work for the discipline "Radio Automation" is carried out in a computer classroom on modern computers in the MatLab software environment using the Simulink package. The classroom is equipped with 12 computers, allowing each student to work independently. The computer lab also has a large screen on which the instructor demonstrates and explains the implementation of more complex tasks in the simulation of radio automation systems. However, it is not prohibited to perform tasks on their own laptops if it is more convenient for students; for this purpose, there are specially designated seats without computers in the classroom.

The working program of the academic discipline (syllabus):

Compiled by N. O. Laschevska; S. O. Sokolsky;

Approved by the PRE Department (Minutes No. 06/2024 dated 06/27/2024)

Approved by the methodological commission of the faculty/research institute (protocol No. 06/2024 dated 28.06.2024)