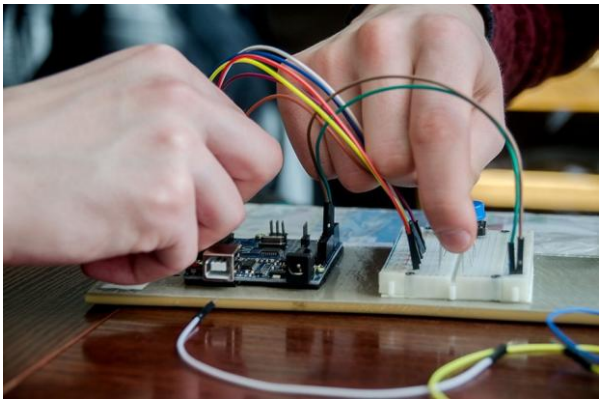
Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Department of Applied Radio Electronics

[RE-93] INTRODUCTION TO THE SPECIALITY



Curriculum of the academic discipline (Syllabus)

Course details

Level of higher education	First (bachelor's)
Field of knowledge	G Engineering, Manufacturing and Construction
Specialty	G5 Electronics, Electronic Communications, Instrument
Educational program	172B ITR - Intelligent Technologies in Radio Electronics (EDEBO id: 49229) 172B ICR - Information and Communication Radio Engineering (EDEBO id: 49228) 172B RCS - Radio Engineering Computerized Systems (EDEBO id: 49227) 172B ITR+ - Intelligent Technologies in Radio Electronics (EDEBO id: 57907) 172B ICR+ - Information and Communication Radio Engineering (EDEBO id: 57910) 172B RCS+ - Radio Engineering Computerized Systems (EDEBO id: 57920)
Status of the discipline	Regulatory Full- time
Form of higher education	1st year, fall semester
Year of training, semester	2 credits (lectures, practical classes, laboratory work 30 hours, independent work 30 hours)
Scope of the discipline	Credit
Semester control/control measures	https://rozklad.kpi.ua
Class schedule	Lab: Adamenko V. O., https://do.ipo.kpi.ua/course/view.php?id=1796
Language of instruction	
Information about the course supervisor/teachers	
Course location	

Curriculum

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

The content of the course is to familiarize students with the specifics of specialty G5 Electronics, Electronic Communications, Instrument and Radio Engineering and further study in the educational programs of the Radio Engineering Faculty.

This discipline introduces students to all stages of designing modern radio-electronic equipment and consists of two parts:
1) design and manufacture of the device;
2) creation of projects on the Arduino software and hardware platform.

The discipline has a pronounced practical focus, as it includes 16 laboratory classes during which students will be able to try their hand at developing radio-electronic devices.

In the first half of the semester, students will be able to design a printed circuit board for a light sensor in DipTrace, then manufacture it and solder the device. The second half of the semester involves studying the capabilities of the Arduino software and hardware platform, namely: familiarization with the platform, features of input and output of digital and analog signals, features of working with additional modules (temperature and humidity sensors, seven-segment indicators, radio modules, etc.).

The aim of the credit module is to develop students' abilities to:

- Perform calculations of elementary electrical circuits;
- Develop and manufacture simple printed circuits based on ready-made diagrams;
- Use modern modular solutions (Arduino and various additional modules) to implement simple control and management systems;
- Program microcontrollers (based on the Arduino software and hardware platform).

Main tasks of the credit module.

In accordance with the requirements of the academic discipline, after completing the credit module, students must demonstrate the following learning outcomes:

knowledge:

the main stages of radio-electronic equipment design; standard designations of electrical circuit elements in electrical schematic diagrams; methods for calculating elementary electrical circuits; principles of microcontroller operation; binary number system; basics of microcontroller programming; methods for placing components on a printed circuit board; stages of printed circuit board design.

skills:
read electrical schematic diagrams; apply Ohm's law to calculate elementary electrical circuits; match elements of electrical schematic diagrams with corresponding electronic components; assemble elementary electrical circuits on a breadboard; program the Arduino software and hardware platform; develop a wire diagram of a printed circuit board using the DipTrace program; manufacture simple printed circuit boards with subsequent assembly of the corresponding components.

Experience:
working with the Arduino software and hardware platform; prototyping electrical circuits; working with DipTrace software; performing technological operations for the manufacture of printed circuit boards; assembling electronic components and printed circuit boards.

The discipline belongs to the normative educational components of the general training cycle.

The discipline develops the following competencies in accordance with the educational program:

General:
GC 02 - Ability to apply knowledge in practical situations.
GC 04 - Knowledge and understanding of the subject area and understanding of professional activity.
GC 07 - Ability to learn and master modern knowledge

Professional:
PC 08 - Willingness to promote the implementation of promising technologies and standards.

Program learning outcomes according to the OP:
PLO 01 - Analyze and make informed decisions when solving specialized tasks and practical problems in telecommunications and radio engineering, which are characterized by complexity and incomplete certainty of conditions.
PLO 07 - Competently apply terminology in the field of telecommunications and radio engineering;
PLO 14 - Apply understanding of the basic properties of the component base to ensure the quality and reliability of telecommunications and radio engineering systems and devices.
PLO 18 - Find, evaluate, and use information from various sources necessary for solving professional tasks, including reproducing information through electronic search.

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

The discipline does not require specific knowledge to pass.

According to the educational program, the post-requisites for study are:
- Fundamentals of metrology

3. Contents of the academic

discipline List of laboratory works:

Lesson 1. Electrical schematic diagram. Electronic components
Lesson 2. Printed circuit boards. Computer-aided design systems
Lesson 3. Printed circuit board design
Lesson 4. Printed circuit board manufacturing
Lesson 5. Mounting electronic components
Lesson 6. Arduino software and hardware platform
Lesson 7. Input and output of digital data. Part 1
Lesson 8. Input and output of digital data. Part 2
Lesson 9. Reading analog signals. Transferring data to a computer
Lesson 10. Processing data from analog sensors
Lesson 11. Outputting analog signals
Lesson 12. Controlling the operation of an RGB LED
Lesson 13. Generating signals of different frequencies
Lesson 14. Working with external modules. Seven-segment indicator
Lesson 15. Working with external modules. Temperature and humidity sensor
Lesson 16. Data transfer using radio modules

4. Training materials and resources

Training manual for practical/laboratory work in the discipline when working in the laboratory:
https://ela.kpi.ua/handle/123456789/53558

Website for virtual laboratory work during distance learning:
https://www.tinkercad.com/

Course on the Moodle platform for distance learning:
https://do.ipo.kpi.ua/course/view.php?id=1796

Basic

1. Introduction to the specialty: laboratory workshop [Electronic resource]: textbook for students majoring in 172 Electronic Communications and Radio Engineering / V. O. Adamenko; Igor Sikorsky Kyiv Polytechnic Institute. — Electronic text data (1 file, 4.2 MB). — Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2023. — 127 p. — Access mode: https://ela.kpi.ua/handle/123456789/53558 — Title from the screen.

Information resources

2. Language Reference — Access mode: https://www.arduino.cc/reference/en/ — Title from the screen.

3. xx555 Precision Timers / Texas Instruments — Access mode
http://www.ti.com/lit/ds/symlink/ne555.pdf — Title from screen

4. DipTrace. User Manual / Novarm Ltd, 2021 — Access mode
Access mode: https://www.diptrace.com/books/tutorial_ua.pdf — Title from the screen

Educational content

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

List of classes and their purpose:

No	Title	Purpose
1	Electrical schematic diagram. Electronic components	Familiarize yourself with the electrical schematic diagram, schematic symbols of typical electronic components, and their main parameters. Learn how to determine the parameters of electronic components, find and work with Datasheets
2	Printed circuit boards. Computer-aided design systems	Familiarize yourself with the purpose and methods of manufacturing printed circuit boards. Study the DipTrace automated design system. Transfer the diagram to the Schematic module.
3	Printed circuit board design	Learning the DipTrace automated design system. Creating a printed circuit board in the PCB Layout module.
4	Manufacturing a printed circuit board	Manufacturing a printed circuit board using chemical etching. Getting an idea of the methods of forming a conductor pattern on a printed circuit board.
5	Assembling electronic components	Learn the principles of mounting electronic components on a printed circuit board. Acquire skills in working with a soldering iron and mounting electronic components.
6	Arduino software and hardware platform	Learn about the Arduino hardware platform and the Arduino IDE software environment. Create a simple program to control LEDs.
7	Input and output of digital data. Part 1	Learn how to work with Arduino digital I/O pins. Practical application of conditional jump statements. Writing a program to control the operating modes .
8	Input and output of digital data. Part 2	Reinforce skills in working with digital I/O – Arduino outputs. Creating a decimal counter circuit.
9	Reading analog signals. Transferring data to a computer	Learn how to work with an analog-to-digital converter to read continuous signals from sensors. Learn how to transfer data to a computer from the Arduino platform. Measuring electrical circuit parameters using Arduino.
10	Processing data from analog sensors	Consolidate knowledge of reading and processing analog signals. Write a program to measure the temperature in a room using a thermistor.

11	Outputting analog signals	Learn how to output analog signals from the Arduino platform using pulse width modulation. Develop a program to change the brightness of an LED depending on the ambient lighting.
12	Controlling the operation of an RGB LED	Consolidate knowledge of analog signal output using Arduino. Write a program to control an RGB LED.
13	Generating signals of different frequencies	Learn methods for generating signals of different frequencies using the Arduino platform. Investigate electromagnetic sound emitters. Learn methods for increasing output power using transistors. Create a program to control an electromagnetic sound emitter.
14	Working with external modules. Seven-segment indicator	Learn how to work with external modules and third-party libraries. Develop a program to control a four-digit seven-segment indicator.
No	**Title**	**Purpose**
15	Working with external modules. Temperature and humidity sensor	Reinforce skills in working with a seven-segment indicator. Familiarize yourself with the DHT–11 temperature and humidity module. Create a program for measuring humidity and temperature with data output to a seven-segment indicator.
16	Data transmission using radio modules	Learn how to work with the nRF24L01 radio module. Study the commands for two-way data transmission via the COM port. Write a program that implements chat via a radio channel.

6. Independent work

Independent work by students involves familiarizing themselves with the theoretical information for each practical class on the eve of its conduct.

Policy and control

7. Policy of the academic discipline (educational component)

During classroom study of the discipline, students must:

1. Follow the rules of conduct in the laboratories of the Radio Engineering Faculty
2. Treat models, measuring instruments, computer equipment, etc. with care
3. Make up for missed practical classes within two weeks from the date of the class during consultations set by the teacher

During distance learning, students must:

1. Maintain academic integrity when completing assignments and taking knowledge tests
2. Work synchronously, according to the approved class schedule
3. Make up missed classes independently at a convenient time, but no later than two weeks from the date of the synchronous class

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

The student's rating for the educational component consists of points received for completing and defending 16 practical (laboratory) assignments, with a maximum number of points being 16x6=96 points.

In the last class, the maximum number of points for the semester component is proportionally increased to 100 points (the sum of points for the semester is multiplied by 1.042).

Condition for admission to the exam: completion and defense of all laboratory works.

Rating point system

Defense of work:

- complete mastery of the material during the defense (at least 90% of the required information) — 6 points;
- partial mastery of the material (at least 75%) — 5 points;
- satisfactory knowledge of the material (at least 60%) — 4 points;
- unsatisfactory knowledge of the material (less than 60%) — 0 points;

The work is considered successfully defended if the student scores 4 points out of a possible 6. If the student scores less than 4 points, the work must be defended again. For individual works

, it is permissible to defend a work with 3 points, but the total number of such works must not exceed 6 works per semester.

Bonus and penalty points

Bonus points:

– completion of additional tasks (if any) — up to 10 points (1 point for each additional task).

Penalty points:

– completion or defense of work with a significant delay (more than 2 weeks from the date of completion) — -1 point for the work, but no more than -10 points for all works.

Receiving a grade

Students who have earned more than 60 points during the semester and completed all laboratory work receive a grade according to the table.

Students who have earned less than 60 points, as well as those who want to improve their grade, complete a final exam, and their semester rating is set to zero.

Final exam

The final exam consists of two theoretical questions, each worth 20 points, and a practical question (writing a program for Arduino), worth 60 points.

Theoretical question:

- complete answer (at least 90% of the required information) — 18–20 points;
- sufficiently complete answer (at least 75% of the required information or minor inaccuracies) — 15–17 points;
- incomplete answer (at least 60% correct and some errors) — 12–14 points;
- unsatisfactory answer — 0 points.

Practical question:

- fully functional program, complete understanding of the operation of its individual parts and understanding of the essence of the programmed processes — 54–60 points;
- fully functional program, but partial understanding of the operation of individual parts and the essence of processes — 45–53 points;
- partially working program (does not perform all the tasks) and incomplete understanding of the work of individual parts and the essence of processes — 36–44 points;
- non-functional program or lack of understanding of the operation of individual parts and the essence of processes — 0 points.

Table of correspondence between rating points and university scale grades

Number of points	Rating
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

Equipment for laboratory work:
Computer classroom with 12 Intel Celeron G540 computers, 2.5 GHz, RAM: 4 GB, HDD: 500 GB
Software: DipTrace, Arduino IDE.
Projector: Vivitek D551
Arduino UNO + breadboard kits (20 kits), various Arduino modules according to the content of laboratory work
Electronic components for laboratory work, fiberglass, soldering stations (10 pieces), reagents for the manufacture of printed circuit boards. HoldPeak HP-36K multimeters.

Work program for the academic discipline (syllabus):
Compiled by V. O. Adamenko;
Approved by the PRE Department (Minutes No. 06/2025 dated June 25, 2025)
Approved by the methodological commission of the faculty/research institute (protocol No. 06/2025 dated June 26, 2025)