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

Кафедра програмного забезпечення комп'ютерних систем

SOFTWARE OF AUTOMATIC IDENTIFICATION SYSTEMS

Syllabus

Details of the academic discipline	
Level of higher education	***Second (Master)***
Branch of knowledge	*12 Information technologies*
Specialty	*121 Software engineering*
Educational program	Software engineering of multimedia and information-search systems
Discipline status	*Normative*
Form of education	*Full-time*
Year of training, semester	*1st year, Autumn semester*
Scope of the discipline	*4 credits – lectures: 36 hours, laboratory work: 18 hours, independent work: 66 hours*
Semester control/ control measures	*Exam, midterm test*
Timetable	*According to the schedule for the autumn semester of the current academic year (http://roz.kpi.ua/*
Language of teaching	*English*
Information about head of the course / teachers	*PhD Yuliya Boyarinova, ub@ua.fm, +380671751308*
Placement of the course	

Program of educational discipline

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

Automatic identification of objects is an important aspect in many fields of human activity, one of which is logistics. The use of technologies for the automatic identification of logistics objects makes it possible to simplify the tracking of their location during transportation and warehouse storage, as well as to ensure the processes of control, reporting, etc.

Automatic identification of objects can be based on data presentation technologies based on barcodes, radio frequency identification, smart cards, etc. One of the most common technologies for automatic identification of objects is the technology based on bar coding of information, which provides high accuracy and speed of information input to computer systems and is economically attractive due to the low cost of consumables and available equipment.

The purpose of the discipline "Software support of automatic identification systems" is to study the methods and theoretical foundations of the development and application of means of automatic identification of accounting units; studying the principles of presenting information in a machine-readable form, using documents in a machine-readable form, studying the issues of automation of information processing, creating software, as well as forming students' abilities:

– analyze the task;

– choose the method of presenting information in machine-readable form;

– to form a solution for presenting information in a machine-readable form;

– create specialized software.

The study of the discipline "Software support of automatic identification systems" contributes to the formation of the following competencies and program learning outcomes in students:

Professional competences

PC 3	*Ability to design software architecture, model the operation of individual subsystems and modules.*
PC 8	*Ability to develop and coordinate processes, stages and iterations of the software life cycle based on the application of modern models, methods and technologies of software development*
PC 17	*Ability to apply software engineering methodologies in practice.*

Program learning outcomes

PLO05	*Develop, analyze, justify and systematize software requirements.*
PLO07	*Analyze, evaluate and apply at the system level modern software and hardware platforms to solve complex problems of software engineering.*
PLO08	*Develop and modify software architecture to meet customer requirements*
PLO09	*Choose reasonable paradigms and programming languages for software development; apply modern software development tools in practice.*
PLO017	*Collect, analyze, evaluate the information needed to solve scientific and applied problems, using scientific and technical literature, databases and other sources.*
PLO018	*Develop mathematical and software for research in software engineering*
PLO027	*Be able to design and develop multi-agent information retrieval systems*

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

The discipline "Software of automatic identification systems" is based on the knowledge gained by students during the study of such disciplines as "Programming" of the curriculum of bachelor's training in the specialty 121 Software engineering. OThe theoretical knowledge and practical skills obtained during the mastering of the discipline "Software support of automatic identification systems" ensure the successful completion of course projects and master's theses in the specialty 121 Software engineering.

3. Content of the academic discipline

Topic 1. Automatic identification of accounting units

Topic 2. Principles of presenting information in automatic identification systems

Topic 3. Hardware support of automatic identification systems (AIs)

4. Educational materials and resources

Basic literature

1. *Zhu S., Song J., Hazen B.T., Lee K., Cegielski C. How supply chain analytics enables operational supply chain transparency: an organizational 177 information processing theory perspective. Int. Journal of Phys. Distrib. Logist. Manag., 2018. Vol. 48(1). P. 47–68.*

2. *Pang J., Shen L., Zhang Q., Xu H., Li P. Design of Modern Logistics Management System Based on RFID and NB-IoT. Advances in Intelligent Systems and Computing, 2019. Vol 927. Springer, Cham. https://doi.org/10.1007/978-3-030-15035-8_54*
3. *Wachenfeld S., Terlunen S., X Jiang. Robust 1-D barcode recognition on camera phones and mobile product information display, Mobile Multimedia Processing, Springer, 2010. P. 53–69.*
4. *Barcode types. https://www.activebarcode.com/codes/*
5. *EAN-13 Barcode Specifications. https://barcode1.com.au/ean-13- specifications*
6. *CodeTwo QR Code Desktop Reader & Generator. https://www.codetwo.com/freeware/qr-code-desktop-reader*
7. *Create QR Code. https://createqrcode.appspot.com*
8. *Gabriel Baptista, Francesco Abbruzzese. Hands-On Software Architecture with C# 8 and .NET Core 3: Architecting software solutions using microservices, DevOps, and design patterns for Azure Cloud. Packt Publishing. 2019. 598 p.*

Information resources

Electronic campus of NTUU "KPI". Materials from the discipline "Software of automatic identification systems". – Access mode: http://login.kpi.ua

Educational content

5. Methods of mastering an educational discipline (educational component)

5.1. Lecture classes

Lectures on the discipline are conducted using modern multimedia presentation technologies.

№	The name of the topic of the lecture and a list of main questions	Description of the training session
	Topic 1. Automatic identification of accounting units	
1	*Lecture 1. Purpose of automatic identification systems (AI).*	*Concept of accounting/control unit. Overview of computer identification systems. Examples of the use of CSI.* *Tasks on self-training: p. 6 No. 1.*
2	*Lecture 2. General aspects of building automatic identification computer systems Generalized structure of the SAI database. Software requirements for CSI.*	*2 Lecture 2. General aspects of building automatic identification computer systems Generalized structure of the SAI database. Software requirements for CSI. Life cycle of the accounting/control unit. Requirements for SAI. SAI functions. Computer SAI databases.* *Task on self-training: item 6 #2.*
	Topic 2. Principles of presenting information in automatic identification systems.	
3	*Lecture 3. Principles of presenting information in automatic identification systems.*	*Stages of creation and improvement of machine-readable ways of presenting information. Graphic marks. Stylized fonts. Bar codes. Problems of using machine-readable methods of presenting information* *Task on self-training: item 6 #3.*
4	*Lecture 4. One-dimensional barcodes.*	*Bar code as a method of machine-readable presentation of information. Bar code elements. Barcode symbol. The structure of the barcode*

		symbol. Bar code symbols. Characteristics of barcodes. Classification of barcodes. Overview of existing barcodes. Barcode construction methods *Task on self-training: item 6 #4.*
5	*Lecture 5. One-dimensional barcodes. Barcodes of the "2 of 5" family*	*Barcodes of the "2 out of 5" family and its derivatives: ITF,2/5 matrix Code* *Assignment on self-training: p. 6 No. 5*
6	*Lecture 6. One-dimensional barcodes. Barcodes of the EAN/UPC family*	*EAN/UPC family barcodes:UPC-A,UPC-E,EAN-13,EAN-8* *Tasks on self-training: item 6 #7*
7	*Lecture 7. One-dimensional barcodes. Digital barcodes*	*Digital barcodes: Codabar, MSI, Delta Distance, Plessey, BCD.* *Task on self-training: p. 6 No. 9*
8	*Lecture 8. One-dimensional barcodes. Alphanumeric barcodes*	*Alphanumeric barcodes: Code 39, Code 39 Full ASCII, CIP, Code 93, Code 128, Code 32* *Tasks on SRS: item 6 No. 11*
9	*Lecture 9. Two-dimensional barcodes.*	*Classification of two-dimensional barcodes. Technical features of two-dimensional barcode processing* *Assignment on self-training: item 6 #12*
10	*Lecture 10. Interference-resistant coding*	*Analysis of possible damage to barcode marks. Construction of one-dimensional barcodes with character detection capability. Using Lemming and Reed-Mahrer codes. Ways to increase the interference resistance of two-dimensional barcodes.* *Task on self-training: item 6 No. 14*
Topic 3. Hardware support of automatic identification systems (AIs)		
11	*Lecture 11. Barcode reading hardware* *.*	*Overview of barcode readers. Stationary readers. Table scanner. Slit reader. Portable readers. Laser scanner. CCD scanner. Optical pencil* *Assignment on self-training: item 6 No. 16*
12	*Lecture 12. Software tools for creating and processing barcodes*	*Database development tools. Relational databases.* *Assignment on self-training: item 6 #18*
13	*Lecture 13. Decoders.*	*Classification of decoders. Algorithm of the decoder. The structure of the hardware barcode decoder* *Task on self-training: item 6 #19*
14	*Lecture 14. General structure of the automatic identification system.*	*Components of a computer CSI. Technical requirements for SAI. Characteristics of SAI. Generalized structure of SAI* *Assignment on self-training: item 6 #21*
15	*Lecture 15. Application of barcodes in trade*	*Bar coding of goods. Goods traffic management system*

		Task on self-training: item 6 No. 22
Modular control work		

5.2 Laboratory works

The main tasks of the cycle of laboratory classes: analysis of means and determination of methods of application of barcodes for specific practical tasks.

№ s/p	*Name of laboratory work*
1	*Development of a method of bar coding of a block of alphanumeric data on an accounting unit (up to 10 characters) with increased information density*
2	*Development of the SAI database architecture and the SAI user interface.*
3	*Development of software for coding of SAI source information.*
4	*Development of barcode printing software.*
5	*Development of barcode decoding software.*
6	*Development and adjustment of the SAI software complex.*

Labs are conducted using a student-friendly programming language and versions of development environments provided by developers for educational purposes free of charge.

In conditions of distance learning, all types of classes are conducted using the Zoom service

6. Student's self-training

The discipline "Software support of automatic identification systems" is based on independent preparations for classroom classes on theoretical and practical topics, as well as the performance of individual tasks on topics that are assigned to laboratory work

No. s/p	*The name of the topic submitted for independent processing*	*Number of hours*	*literature*
1	*Preparation for the lecture 1*	*1*	*1,2,3*
2	*Preparation for the lecture 2*	*1*	*1,2*
3	*Preparation for the lecture 3*	*1*	*1-6*
4	*Preparation for the lecture 4*	*1*	*1-6*
5	*Preparation for the lecture 5*	*1*	*1-6*
6	*Preparation for the performance of 1 laboratory work*	*1*	*1-6*
7	*Preparation for the lecture 6*	*1*	*2*
8	*Preparation for modular control work*	*9*	*2*
9	*Preparation for the lecture 7*	*1*	*1-6*
10	*Preparation for the performance of 2 laboratory work*	*1*	*1, 4*
11	*Preparation for the lecture 8*	*1*	*1-6*
12	*Preparation for the lecture 9*	*1*	*2, 5*
13	*Preparation for the performance of 3 laboratory work*	*1*	*3, 4*
14	*Preparation for the lecture 10*	*1*	*1, 2*

15	*Preparation for the performance of 4 laboratory work*	*1*	*2*
16	*Preparation for the lecture 11*	*1*	*2, 3, 4*
17	*Preparation for the performance of 5 laboratory work*	*1*	*2*
18	*Preparation for the lecture 12*	*1*	*3, 4*
19	*Preparation for the lecture 13*	*1*	*2*
20	*Preparation for the performance of 6 laboratory work*	*1*	*1-8*
21	*Preparation for the lecture 14*	*1*	*2, 7*
22	*Preparation for the lecture 15*	*1*	*6,8*
24	*Preparation for the exam*	*36*	*1-8*

Policy and control

7. Policy of academic discipline (educational component)

• Attending lectures and laboratory classes is a mandatory component of studying the material;

• At the lecture, the teacher uses his own presentation material;

• During lectures, it is not forbidden to distract the teacher from teaching the material with questions, clarifications, etc., but it is desirable for students to ask questions at the end of the lecture in the time allotted for this;

• Laboratory work is considered completed if the student has demonstrated the workability of the work and answered the questions. Points for laboratory work are taken into account only if there is an electronic (or printed) report;

• All work must comply with the academic integrity policy.

8. Rating system for evaluating learning outcomes

Semester control is conducted in the form of an exam. A 100-point rating system and a university scale are used to evaluate learning outcomes.

Points for performance and defense of laboratory work

During the semester, students perform 6 laboratory works.

The maximum number of points for laboratory work: 7 points.

Points are awarded for:
- programming quality: 0-3 points;
- answer during the defense of laboratory work: 0-1 points;
- timely submission of work for defense: 0-2 points;
- protocol design quality: 0-1 point.

Additional points are awarded for a creative approach to work, maximum number of additional points for all works: 2 points.

The maximum number of points for performing and defending laboratory work:
6 lab works × 7 = 42 points.

Points for the modular control work

The modular test includes 1 question (problem).

The maximum number of points for answering a question: 8 points.

Evaluation criteria:

7-8 points – the decision is correct;
5-6 points – the decision has flaws;
1-4 points – there are errors in the decision, but the course of the decision is correct;
0 points – there is no solution or the solution is incorrect.

The maximum number of points for the current control
R=Rc=Rlab. rab+Rmcr=42 points +8 points = 50 points.

Points for the performance of the examination work

The exam paper includes 2 questions (task and theoretical question). The maximum number of points for answering a theoretical question: 20 points.

Evaluation criteria:
17-20 points - the solution is correct;
10-16 points – the solution has flaws;
4-9 points – there are errors in the decision, but the course of the decision is correct;
0-3 points – there is no solution or the solution is incorrect.

The maximum number of points for answering a practical question: 30 points.

Evaluation criteria:
25-30 points – the solution is correct;
11-24 points – the decision has flaws;
4-10 points – there are errors in the decision, but the course of the decision is correct;
0-3 points – there is no solution or the solution is incorrect.

The maximum number of points for the examination work:
1 theory dad x 20 points +1 practice. zap x 30 points = 50 points.

The maximum number of points per credit module:
R= R_C + R_E = 50 балів+50 балів = 100 балів.

According to the "Regulations on recognition in KPI named after Ihor Sikorskyi of learning results acquired in non-formal/informal education" (https://osvita.kpi.ua/node/179) it is possible to enroll the entire OC or a separate part (laboratory or calculation work)

Calendar control
Calendar control is carried out twice a semester as a monitoring of the current state of meeting the syllabus requirements.

Semester control
Semester control of study results is conducted in the form of an exam.
Conditions for admission to semester control (examination):
- enrollment of all laboratory works;
- writing a modular test
- starting R_C rating ≥ 30 points (at least 60% of R_C).

The examination assessment consists of an assessment based on the results of a practical task and an answer to a theoretical question. The practical task is assessed at 30 points, the theoretical task at 20 points.

The final grade is formed based on the results of the assessment of the student's knowledge and skills in the semester and on the exam according to the formula: R = R_C + R_E.

Table of correspondence of rating points to grades on the university scale:

Scores	*Rating*
100-95	Excellent
94-85	Very Good
84-75	Good
74-65	Satisfactory
64-60	Fair
Less than 60	Unsatisfactory
Admission conditions not met	Not allowed

The syllabus prepared by PhD, assoc. prof. Yuliya Boyarinova.

Approved by the PZKS department (protocol No. 13 dated 22.06.2022).

Approved by the Methodical Commission of the Faculty of Applied Mathematics (protocol No. 9 dated 24.06.2022).