MINISTRY OF EDUCATION OF THE REPUBLIC OF AZERBAIJAN

Approved by the decision No.
____ dated ___ ___ 2020
of the Ministry of Education
of the Republic of Azerbaijan.

BACHELOR'S DEGREE LEVEL (UNDERGRADUATE EDUCATION) EDUCATIONAL PROGRAM FOR THE SPECIALTY

Code and title of the specialty (program): 050620 – "Computer Engineering"

BAKU – 2020

Bachelor’s Degree Program in Specialty 050620 – Computer Engineering

1. General Provisions

1.1. The Bachelor's Degree Program at the main level for Specialty 050620 – Computer Engineering (hereinafter referred to as the Specialty Education Program) is developed in accordance with the Law of the Republic of Azerbaijan "On Education," relevant decisions of the Cabinet of Ministers of the Republic of Azerbaijan, as well as the "Classification of Specialties (Programs) for Bachelor's Higher Education at the Basic Level."

1.2. The objectives of the Education Program are as follows:

- To define the competencies of graduates in the specialty, the scope of the specialty, teaching and learning methods for courses, assessment methods, learning outcomes, requirements for infrastructure and personnel potential for training, and opportunities for students to undergo internships, employment, and further education;
- To inform students and employers about the knowledge and skills acquired by graduates, as well as the learning outcomes;
- To inform experts involved in evaluating the compliance of personnel training with this program during the accreditation process.

1.3. The Education Program is mandatory for all higher education institutions operating in the Republic of Azerbaijan, regardless of their subordination, ownership type, or organizational-legal form, that provide undergraduate basic training in the specified specialty.

1.4. The student's total weekly workload in a five-day work schedule is 45 hours, including both classroom and extracurricular activities (except for specialized higher education institutions). The volume of weekly classroom hours should not exceed 50% of the total weekly workload. Depending on the specialty's characteristics, the weekly workload may be adjusted.

2. Graduate Competencies

2.1. By the end of the Education Program, the graduate should acquire the following **general competencies**:

- Oral and written communication skills in Azerbaijani within the scope of the specialty;
- Communication skills in at least one foreign language related to the specialty;
- Systematic and comprehensive knowledge of the historical, legal, political, cultural, and ideological foundations of Azerbaijani statehood, as well as its position and role in the modern world, and the ability to forecast the prospective development of the national state;
- Ability to identify threats and challenges facing the national state;
- Ability to use information technologies in the workplace;
- Ability to work in a team and to achieve a collaborative approach to problem-solving;
- Ability to adapt to new environments, show initiative, and maintain the will to succeed;
- Ability to identify and select additional information resources for problem-solving;
- Skills to analyze, synthesize, and apply relevant information for professional purposes;
- Ability to plan and organize professional activities, improve existing skills and education, manage time, and complete tasks on schedule;
- Awareness of social and environmental responsibility in activities, as well as civic consciousness, ethical conduct, and a commitment to quality;
- Ability to reassess both the situation and oneself in order to develop knowledge and skills.

2.2. By the end of the Education Program, the graduate should acquire the following **professional competencies**:

- Ability to apply information and communication technologies, including computer systems and networks, in government institutions, research institutes, educational institutions, and various organizations and companies;
- Ability to work with systems for acquiring knowledge in the main areas of computer engineering, including automated and integrated computer technologies;
- Ability to use relevant knowledge in sciences, languages, and information technology (IT) to apply ICT capabilities in various fields.

- Ability to develop and implement system, application, and specialized software tools, as well as information and communication technologies, for solving problems in computer engineering;
- Ability to use application and specialized software packages designed for managing various technological processes;
- Ability to design computer systems and networks, monitor their functionality, apply new technologies, install additional equipment, and develop software products;
- Ability to apply design methods for computers, computer networks, computing and information systems, and their components in the field of computer engineering;
- Ability to apply programming languages and software development tools to solve computer engineering problems;
- Ability to perform tasks related to the development, installation, use, configuration, maintenance, and performance control of modern computer systems and networks, including hardware and software tools;
- Ability to work with modern information and communication technologies, software-hardware solutions, and computer systems and networks in the field of computer engineering, as well as to build and manage information systems using these technologies;
- Ability to develop and apply tools based on computer graphics, multimedia, and virtual reality technologies;
- Ability to design, test, integrate, and manage databases, user interfaces, and core modules of information systems;
- Ability to develop software for various technological devices using modern programming technologies and to identify and resolve defects and malfunctions;
- Understanding the operating principles of devices used in the computer-controlled automation of technological processes in industry, and the ability to intervene in their functioning at the software level;
- Skills and abilities to apply existing engineering solutions and technologies to the hardware and software components of computer systems and networks;
- Ability to apply computer systems and networks, information systems, and processes to support decision-making under uncertainty in management;
- Ability to organize professional activities in the field of computer engineering on a scientific basis, including the collection, storage, protection, processing, and transmission of professional information, and the purposeful use of this information;
- Ability to select, study, summarize, and prepare reviews of scientific-technical literature, regulatory and methodological documents for solving professional tasks;
- Ability to gather the necessary knowledge in the field of computer engineering, apply it in relevant contexts, and express it briefly and precisely;
- Ability to prepare professional presentations in accordance with modern requirements, engage in business communication, and lead engineering projects within teams in the relevant field;
- Ability to apply essential mathematical methods for solving problems in computer engineering;
- Ability to use modeling techniques (including mathematical modeling) for analyzing and evaluating computer systems, networks, information processes, and systems.

3. Structure of the Education Program

3.1. The Education Program must consist of **240 ECTS credits (4 years)**. The credits are distributed as follows:

Table 1

Number of Courses	Course Title	ECTS Credit
General Courses		30
1	**Azerbaijani History** This course studies the emergence, formation, and development of modern Azerbaijani statehood traditions. It analyzes and examines the role of political, ideological, economic, and cultural factors in the formation of modern Azerbaijani statehood. The position and role of the Republic of Azerbaijan in the contemporary world are systematically analyzed.	5
2	**Business and Academic Communication in Azerbaijani** Within the scope of this course, special emphasis is placed on developing students' skills in delivering presentations, public speaking, academic writing, and business correspondence in the Azerbaijani language.	4

3	**Business and Academic Communication in a Foreign Language** Within the scope of this course, special emphasis is placed on developing students' skills in delivering presentations, public speaking, academic and business writing, as well as oral and written communication in a foreign language relevant to their specialty.	15
	Elective Courses (Elective courses are determined by the higher education institution. Depending on the specifics of the specialty, additions may be made to the list of elective courses.)	6
4	Philosophy	3
	Sociology	
	Constitution of the Republic of Azerbaijan and Fundamentals of Law	
	Logic	
	Ethics and Aesthetics	
	Multikulturalizmə giriş	
5	Information Technologies (Specialty-specific)	3
	Information Management	
	Fundamentals of Entrepreneurship and Introduction to Business	
	Political Science	
Specialty Courses		120
6	**Linear Algebra and Analytic Geometry** This course covers complex numbers, matrices and determinants, linear spaces and their bases, systems of linear equations and methods for solving them, linear transformations and quadratic forms, Cartesian coordinate systems in the plane and space, basic problems in analytic geometry, elements of vector algebra, equations of lines and planes, and algebraic curves and surfaces of the second order.	3
7	**Mathematical Analysis** This course includes elements of set theory, the concept of limits of sequences, limits and fundamental properties of single-variable functions, continuity at a point and on sets, uniformly continuous single-variable functions on sets, differential and integral calculus of single-variable functions, numerical and functional series, Euclidean space of multiple dimensions, limits, continuity, and uniform continuity of multivariable functions, differential and integral calculus of multivariable functions, introduction to first-order ordinary differential equations and systems, and general information on n-th order ordinary differential equations.	7
8	**Differential Equations** This course covers first-order ordinary differential equations and systems, methods for constructing solutions of n-th order ordinary differential equations, investigation of existence, uniqueness, and stability of solutions to Cauchy and boundary value problems for these equations, application of differential equations to the mathematical modeling of various processes in natural sciences, classification of partial differential equations, and knowledge of the formulation and well-posedness of Cauchy and boundary value problems for equations in mathematical physics.	3
9	**Discrete Mathematics** This course studies the fundamental elements and concepts of information theory, mathematical logic, graph theory, algorithm theory, set theory—including fuzzy sets and relations theory—and combinatorics, along with their principles of application in computer engineering. Within the scope of the course, Boolean algebra, relations, fuzzy relations, linguistic variables, predicate calculus, information encoding, measurement of information quantity, units of measurement, and number systems are covered.	3
10	**Probability Theory and Mathematical Statistics** This course covers events and operations on them, various definitions of probability and methods for its calculation, application of the law of total probability and Bayes' theorem, distribution laws of discrete and random variables and their numerical characteristics, the essence of the law of large numbers and the central limit theorem, fundamental elements of mathematical statistics, statistical estimation based on parameter selection, and laws related to the normal distribution.	3
11	**Physics** This course covers classical mechanics, including vector algebra, particle kinematics and dynamics, energy and acceleration, conservation laws, rotational dynamics, oscillatory motion, gravitation, thermodynamics, and the kinetic theory of gases. It also includes electrostatics, conductors and insulators, DC circuits, magnetic forces and fields, magnetic effects of moving charges and currents, electromagnetic induction, Maxwell's equations, electromagnetic oscillations and waves, as well as geometric and physical optics.	5
12	**Fundamentals of Computer Engineering** This course covers the objectives and tasks of the computer engineering specialty, its connections with other fields, future prospects, and computer work habits; the history of computer technology development and its fundamental theoretical concepts; modern computer and computing technologies; concepts of artificial intelligence and intelligent systems; computer architecture and organization; basics of computer systems and operating systems; stages of problem-solving on computers and methods; programming and algorithmization technologies; programming languages; general principles of algorithm construction; program structure, correctness, and efficiency; as well as data types and control structures.	8

13	**Basics of Programming** This course covers the stages and methods of problem-solving on a computer; general principles of algorithm construction; the concept of a programming system; program structure; data types, operators, and operations; control structures; arrays, strings, pointers, files; subprograms; object-oriented programming model; concepts of classes and objects, their properties, and methods.	8
14	**Data Structures and Algorithms** This course covers fundamental data structures including static and dynamic data structures, queues, stacks, trees, and graphs; applications of trees and graphs; balanced trees; heaps; memory management; caching techniques; sorting, searching, string operations, and graph algorithms. It also includes fundamental algorithms from various other fields, such as geometric algorithms and some algorithms from operations research. The course focuses on developing algorithms, understanding their performance characteristics, and evaluating their potential efficiency in applications.	6
15	**Database Systems** This course covers data modeling; normalization; the relational model; database design and construction; query languages; simple and complex queries; conceptual modeling; hierarchical, network, and relational models. It teaches how to establish and manage relationships within a database system.	7
16	**Operating Systems** This course provides an efficient and user-friendly interface between user applications and computer hardware. It covers the fundamental principles of modern operating system design, including the architecture of Windows, Unix, Linux, Mac OS, and mobile operating systems. Students learn the core functions of operating systems, utilities, antivirus packages, as well as various network protocols, hardware, and software tools used in building modern computer networks.	8
17	**Computer Networks** Introduction to computer networks, network requirements, and layered architecture; ISO reference model; data encoding/decoding; error detection and correction; Ethernet and FDDI. Network layer and WAN, IP and routing, circuit switching and ATM, bridges, the Internet—global network. End-to-end protocols including UDP, TCP, and RPC. Application layer, security, Domain Name System (DNS), and WWW protocols are covered. This course also addresses the hardware required to connect digital devices for data transmission over networks, including bus architectures, ports, network cards, cables, routers, and switches. Topics include ensuring network reliability and optimizing network performance**.**	8
18	**Computer Architecture** This course explains the representation of numbers and characters in a computer, describes the computer's I/O system and interaction structures, and outlines the design of the CPU. It covers the principles of operation of internal and external memory systems, virtual memory, and peripheral devices.	8
19	**Theory of Computation** This course explains the architecture of microprocessors and multicore processors; the instruction set architecture of computers; number systems; organization and management of memory; interrupts; and input/output devices.	7
20	**Fundamentals of Electronics** This course covers current and voltage; voltage and current sources; Ohm's law; power and energy; series and parallel circuits; Kirchhoff's voltage and current laws; Thevenin and Norton theorems; capacitors and inductors; Laplace and Fourier transforms. It also examines important problems in the design and application of operational amplifiers.	6
21	**Digital Systems** This course teaches the methodology for analyzing the operation of data transmission and reception systems, knowledge of the main directions in telecommunications development, and basic telecommunications concepts. It develops the ability to determine key characteristics of data transmission and reception systems' signal processing, understand the main features of digital codes, calculate parameters of subsystems, and design their structural diagrams.	7
22	**Computer Systems Security** This course covers information security and its main properties; threats and risks to information resources; channels of information leakage; cryptosystems and encryption methods; steganography; information hiding techniques; network security; security attacks; digital signature technology; and the use of security measures to protect computers and information from cyber-attacks and unauthorized access.	8
23	**Computer Graphics** This course covers computer graphics, color schemes, types of graphics including raster, vector, and fractal graphics, 3D graphics, their characteristics, widely used graphic editors and their working principles, as well as multimedia tools.	5
24	**Computer Modeling** This course teaches how to select and analyze existing problems in various fields of activity, conduct computer experiments, and determine the degree of model conformity to the original; how to select, build, and analyze mathematical and computer models in different fields; how to perform individual stages of computer simulation using main programming systems; how to select software for building computer models; and how to work with the chosen software tools.	7

25	**Civil Defense** This course teaches students about civil defense, methods to protect the state's citizens (generally non-combatants) from military attacks and natural disasters; principles of emergency operations including prevention, mitigation, preparedness, response actions, as well as urgent evacuation and recovery measures.	3
	Elective Courses Determined by the Higher Education Institution[1] The courses listed here are individually determined by each higher education institution and are included in the curriculum of the respective specialty**.**	60
	Internship	30

Table 2

Specialty	General Courses	Specialty (or Major) Courses (including Civil Defense)	Courses Determined by ATM	Internship	Total
050620 - Computer Engineering	30	120	60	30	240

4. Teaching and Learning

4.1. The teaching and learning environment must be organized so that students can achieve the intended learning outcomes of the education program. The courses should be proposed by the higher education institution considering the experience of the academic staff, research infrastructure, and local and international employment opportunities. Elective courses determined by the higher education institution should have a selective character for students and also facilitate their participation in international exchange programs.

4.2. Teaching and learning methods must be described in relevant documents (for example, in the instructor's syllabus) and made publicly accessible (for instance, on the university's website, program brochures, etc.).

4.3. Teaching and learning methods should be continuously reviewed and improved, taking into account innovative educational practices. Regular enhancement of teaching and learning methods should be an integral part of the university's quality assurance system.

4.4. Different teaching methods should be used during the educational process. These methods must promote a student-centered approach and encourage active participation of students in the learning process. Examples of teaching and learning methods that can be used include:

- Lectures, seminars, practical assignments;
- Presentations and discussions, debates;
- Independent work/research (e.g., working with practical examples);
- Projects;
- Problem-based learning;
- Fieldwork;
- Role-playing;
- Reports;
- Group assessments;
- Expert method;
- Video and audio conferencing technologies;
- Video and audio lectures;
- Distance education;
- Simulations;
- etc.

- **4.5.** A balance between theoretical education and practical training should be maintained. The main focus must be on strengthening practical skills in accordance with the changing demands of the labor market.

- **4.6.** The education program should support students' independence and promote the concept of lifelong learning. By the end of the education process, students should be able to work independently in any direction and continue their education throughout their lifetime.

5. Assessment

5.1. Assessment should be organized in a way that effectively measures whether students achieve the expected learning outcomes. It should help monitor progress, evaluate the extent to which the educational program's goals have been met, facilitate communication with students, and support the formation of initial conditions for improving the educational programs.

5.2. Assessment methods must be described in relevant documents (for example, course programs, syllabi, etc.) and be accessible to everyone (for example, on the university's website, in program brochures, etc.).

5.3. Assessment methods should be continuously reviewed and improved, taking into account innovative teaching practices. Regular updates of assessment methods must be a part of the higher education institution's quality assurance system.

5.4. Different assessment methods should be used during the teaching process. These methods should promote a student-centered approach and encourage active participation of students in the learning process. Examples of assessment methods that can be used include:

- written assignments;
- oral presentations;
- surveys;
- open discussions;
- practical reports, fieldwork reports;
- assessment of skills based on observations in practice and laboratory;
- reports on project work;
- group and self-assessment;
- etc.

5.5. The methods used to assess learning outcomes must be based on clearly defined criteria and should accurately and reliably measure the level of knowledge, skills, and abilities acquired by the student during the education process. In assessing learning outcomes, instructors must uphold principles of transparency, impartiality, mutual respect, and humanism.

5.6. Students must be given the opportunity to discuss all aspects of their education, including the assessment process, with teachers and evaluators. The higher education institution should establish procedures for the assessment process and appeal mechanisms related to grading.

5.7. Academic ethics holds an important place in the education process. Students are taught to adhere to academic honesty and to understand the issue of plagiarism. They should be informed about intellectual property rights related to intellectual work.

6. Learning Outcomes of the Program and Each Course

6.1. The determination of the learning outcomes of the educational program, as well as the learning outcomes of each course and the preparation of the syllabus for each course, are under the authority of the higher education institution/academic staff.

6.2. The learning outcomes are defined by each higher education institution in accordance with the form in Appendix 1. The relationship between courses and learning outcomes must be reflected in the learning outcomes matrix (Appendix 2).

6.3. In order for the Educational Program to provide theoretical and practical content that meets the changing needs of society and the labor market, the syllabi of courses must be regularly updated.

7. Infrastructure and Human Resources

7.1. The teaching, learning, and assessment process of the Educational Program requires that the higher education institution have the following infrastructure: appropriate classrooms, laboratories, computer labs, and other facilities necessary for conducting lectures, practical, and laboratory sessions for the courses specified in the curriculum. Additionally, it must have a modern material and technical base equipped with up-to-date equipment for carrying out scientific research activities. Students should be provided access to the institution's local network, the Internet, information databases, electronic libraries, and search systems.

7.2. The academic staff of higher education institutions usually possess academic degrees. Individuals from other public or private institutions and/or relevant organizations may also be involved in teaching.

8. Internship

8.1. Internship/practical training is important for applying the student's theoretical knowledge in practice and for strengthening professional skills.

8.2. Internships can be organized in private companies, state institutions, research laboratories, as well as universities, private local or international organizations and companies, etc.

8.3. Before the internship begins, a contract must be signed between the higher education institution and the company/institution where the internship will take place. At the same time, based on the student's individual request, permission may be granted to undertake an internship at another company/institution appropriate to the student's specialty, including abroad. The contract should specify the terms, the rights and responsibilities of the students, and other necessary details.

8.4. Internship assessment: During the internship, the student must write a report on the results of the internship project conducted at the production enterprise or company and defend it before a commission consisting of representatives from the university's academic staff and the internship site. The results of the internship program implementation are evaluated in a form determined by the educational institution.

9. Employment and Lifelong Learning

9.1. Graduates of the "Computer Engineering" program work in modern information technologies, including information processes, information resources, information systems, scientific and technical information databases, knowledge bases, information products, and services. They are employed in relevant government and non-government organizations, companies, and agencies, and can work in roles such as information systems management, electrical engineer, systems engineer, and software engineer.

9.2. The higher education institution must conduct regular surveys regarding the employment of graduates of the Education Program and also publish information about job vacancies on its website.

9.3. Master's programs that bachelor's degree graduates can pursue: A bachelor who has mastered the main education program of higher professional education based on the "Computer Engineering" specialty education program has the right to continue their education at the master's level in relevant specialties.

9.4. The knowledge, skills, and approaches acquired during the education period are the fundamental prerequisites for graduates to independently pursue lifelong learning.

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Razılaşdırılmışdır:

Azərbaycan Respublikasının Təhsil Nazirliyinin Aparat rəhbərinin müavini, Elm, ali və orta ixtisas təhsil şöbəsinin müdiri

Yaqub Piriyev

"17" 07 2020-ci il

Texniki və texnoloji ixtisaslar qrupu üzrə Dövlət Təhsil Proqramlarını hazırlayan işçi qrupun sədri, prof.

M.Babanlı Mustafa Babanlı

"16" 07 2020-ci il

Appendix 1

Learning Outcomes of the Education Program and Courses

The higher education institution must determine the expected learning outcomes for the Education Program and for each course. At least 6 learning outcomes should be listed in the tables below (separately for the Education Program and for each course).

Education Program Learning Outcomes (PLOs)
PLO 1. Possess knowledge of Azerbaijani history, communicate effectively in Azerbaijani language for business purposes, and understand and convey scientific and technical information in a foreign language.
PLO 2. Ability to algorithmize, write programs in programming languages, understand data structures, modeling methods of data representation, organization and processing in computers, and design databases and information systems.
PLO 3. Master the fundamentals of computer engineering, computer systems, software, operating systems, computer graphics, and multimedia systems.
PLO 4. Ability to build, apply, and maintain computer systems and networks; manage networks and understand and apply network technologies, including OSI and TCP reference models.
PLO 5. Understand computer system security, cryptography, steganography, and methods and algorithms for encryption and information hiding.
PLO 6. Knowledge of mathematical and physical foundations of computer systems and information technologies, including computer modeling and computational methods.

Course Learning Outcomes (CLOs)
CLO 1. Demonstrate proficiency in Azerbaijani for fluent communication, and understand, read, and express ideas in at least one foreign language.
CLO 2. Understand the mathematical and logical foundations of information technologies, the characteristics of physical elements, and their applications in ICT.
CLO 3. Learn the basics of programming, system programming, operating systems, database creation, principles of systematic information analysis, and modeling of information processes and systems.
CLO 4. Understand the construction of computer networks, network administration, and network technologies.
CLO 5. Learn about information security issues in computer systems and networks, as well as methods and tools to combat them.
CLO 6. Apply methods and algorithms for modeling and solving various types of problems on computers and understand the principles of implementing computing systems.

Appendix 2

Matrix of Course Learning Outcomes (CLOs) and Program Learning Outcomes (PLOs)

The higher education institution should use the table below to determine how the study program of the specialization supports the achievement of the Program Learning Outcomes (PLOs).

Course Titles	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
Business and Academic Communication in Azerbaijani	X					
History of Azerbaijan	X					
Business and Academic Communication in a Foreign Language	X					
Linear Algebra and Analytic Geometry		X	X			X
Mathematical Analysis		X	X			X
Discrete Mathematics		X	X			X
Differential Equations		X	X			X
Probability Theory and Mathematical Statistics		X	X			X
Physics						X
Fundamentals of Computer Engineering		X	X	X	X	X
Computer Architecture		X	X			
Fundamentals of Programming		X	X			X

Data Structures and Algorithms		X	X			X
Database Systems		X	X			X
Theory of Automata (or Automata Theory)						X
Fundamentals of Electronics						X
Operating Systems			X	X		X
Computer Graphics			X			
Digital Systems						X
Computer Systems Security					X	
Computer Networks				X	X	
Computer Modeling		X				X
Civil Defense						