National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"

Department
biomedical engineering

Object-Oriented Programming

Working program of basic discipline (Syllabus)

Requisites for basic discipline	
Level of higher education	***First (bachelor's)***
Branch of knowledge	*16 Chemical engineering and Bioengineering*
Specialty	*163 Biomedical Engineering*
Educational program	*Medical Engineering*
Discipline status	*Mandatory discipline*
Form of study	*full-time (day) / mixed / remote*
Year of preparation, semester	*2 course (spring semester)*
The scope of discipline	*5 ECTS credits / 150 hours*
Semester control / Control measures	*Test Work, Modular Test Work, Calculation and Graphic Work*
Lessons schedule	*According to the schedule on the site http://rozklad.kpi.ua/*
Language of instruction	*English*
Information about course leader / teachers	***Lecturer:*** *Senior Lecture of BME Department Valentyna Danilova, e-mail – valnaa@ukr.net, Telegram - https://t.me/danilova_valentyna.* ***Practical:*** *Senior Lecture of BME Department Valentyna Danilova, e-mail – valnaa@ukr.net, Telegram - https://t.me/danilova_valentyna.*
Course placement	*Platform «Moodle» - https://do.ipo.kpi.ua/course/view.php?id=3961*

Distribution of hours

Semester	Lectures	Practical	Laboratory	Independent Work
spring semester	*36*	*36*		*78*

Curriculum of the discipline

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

The main purpose of the discipline "Object-Oriented Programming" is the study of a modern approach to software development based on object-oriented paradigms and technology, students gain knowledge about the object-oriented approach in programming, mastering the concept of object-oriented approach and its practical application, learning the capabilities of the C + + language with an emphasis on solving object-oriented design problems of modern software systems.

The discipline "Object-Oriented Programming" studies the concept of object-oriented programming, methods and means of its implementation in the environment of visual programming.

General competencies *(OPP was put into effect by the Rector's Order NON/ 89/2021 of 19.04.2021):*

GC 1 *- Ability to apply knowledge in practical situations.*
GC 2 *- Knowledge and understanding of the subject area and understanding of professional activity.*
GC 3*- Ability to communicate in the state language both orally and in writing.*
GC 4 *- Skills in the use of information and communication technologies.*
GC 5 *- Ability to perform research at the appropriate level.*

GC 6 *- Ability to search, process and analyze information from various sources.*
GC 7 *- Ability to generate new ideas (creativity).*
GC 8 *- Ability to make well-grounded decisions.*
GC 9 *- Ability to communicate with representatives of other professional groups of different levels (experts from other fields of knowledge / types of economic activity).*
GC 10 *- Skills in conducting safe activities.*
GC 11 *- Ability to assess and ensure the quality of work performed.*

Special (professional) competencies *(OPP was put into effect by the Rector's Order NON/ 89/2021 of 19.04.2021):*

PC 5 *- Ability to apply physical, chemical, biological and mathematical methods in the analysis, modeling of the functioning of living organisms and biotechnical systems.*
PC 6 *- Ability to effectively use tools and methods for analysis, design, calculation and testing in the development of biomedical products and services.*

The program learning outcomes *after studying the discipline "Object-Oriented Programming " are (OPP was put into effect by the Rector's Order NON/ 89/2021 of 19.04.2021):*

PLO 1 *- The ability to apply knowledge of the fundamentals of mathematics, physics and biophysics, bioengineering, chemistry, engineering graphics, mechanics, materials resistance and strength, properties of gases and liquids, electronics, computer science, signal and image acquisition and analysis, automatic control, system analysis, and decision-making methods at a level necessary for solving biomedical engineering tasks.*
PLO 5 *- Be able to use databases, mathematical and software tools for data processing and computer modeling of biotechnical systems.*
PLO 20 *- Knowledge and application of research methods in biomedical engineering, methods and tools for organizing and processing experimental data, statistical methods for modeling and simulating processes and systems of physical and biological nature, modern programming technologies and supporting tools, methods for designing digital and microprocessor-based medical systems.*

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

The discipline "Object-Oriented Programming" belongs to the cycle of professional training and has an interdisciplinary nature. According to the structural and logical scheme of the training program, the discipline "Object-Oriented Programming" is closely related to other disciplines of training, such as Telemedicine and Computer Networks, Automatic Control Theory and is the basis for further practical work in the specialty.

3. The content of the discipline

The main sections and topics that will be considered in the process of studying the course:

Section 1. Introduction. Programming technology

Topic 1.1. History and purpose of the C ++ language
Topic 1.2. Names, variables and constants

Section 2. Developer software environment

Topic 2.1. Operations and expressions
Topic 2.2. Operators
Topic 2.3. Cycles in C ++.

Section 3. Basic concepts of OOP programming language

Topic 3.1. One-dimensional arrays in C ++.

Topic 3.2. Two-dimensional arrays in C ++.

Topic 3.3. Functions

Topic 3.4. Recursion

Topic 3.5. Sorting methods.

Topic 3.6. Structures in C ++.

Chapter 4. Object-Oriented Programming

Topic 4.1. Built-in data types

Topic 4.2. Classes

Topic 4.3. Encapsulation

Topic 4.4. Polymorphism. Operator overload.

4. Training materials and resources

Basic literature:

1. А. Л. Фридман. Язык программирования С++ (2-е изд.). – М. : НОУ «Интуит», 2016. – 218 с.
2. Б. Л. Голуб, Є. М. Шукайло. Методичний посібник до вивчення дисципліни «Програмування та алгоритмічні мови». Методичний посібник. – Видавничий центр НАУ, 2003. – 64 с.
3. Б. Керниган, Д. Ритчи. Язык программирования С. – Санкт-Петербург, 2001. – 300 с.
4. Х. М. Дейтел, П. Дж. Дейтел. Как программировать на С/С++. – М. : «Бином», 2000. – 1005 с.

Additional literature:

1. http://www.cplusplus.com/ - Сайт з довідкою по С++
2. http://cppstudio.com - Сайт з ресурсами по вивченню С++
3. https://msdn.microsoft.com/ru-RU/ - керівництво по продуктам Microsoft
4. https://msdn.microsoft.com/ru-RU/library/60k1461a.aspx - зокрема Visual Studio 2013 С++
5. http://cppstudio.com – сайт присвячений програмуванню на С++

Educational content

5. Methods of mastering the discipline (educational component)

№ s/n	Subject	Program learning outcomes	The main tasks	
			Control measure	Deadline
Spring semester, 5 ECTS credits / 150 hours				
1.	History and purpose of the C ++ language.	PLO 20	-	1st week
2.	Data types. Variables and constants.	PLO 20	Practical work 1	2nd week
3.	Arithmetic operations.	PLO 20	Practical work 2	3th week
4.	Memory and information storage.	PLO 20	Practical work 3	4th week
5.	Organization of data input-output.	PLO 20	Practical work 4	5th week
6.	Comparison operators. Logical join operations.	PLO 1 PLO 5 PLO 20	Practical work 5	6th week

№ s/n	Subject	Program learning outcomes	The main tasks	
			Control measure	Deadline
7.	Selection operators.	PLO 5 PLO 20	Practical work 6	7th week
8.	Loops in C ++.	PLO 5 PLO 20	Practical work 7	8th week
9.	One-dimensional arrays in C ++.	PLO 5 PLO 20	Practical work 8	9th week
10.	Two-dimensional arrays in C ++.	PLO 5 PLO 20	Practical work 9	10th week
11.	Application of functions.	PLO 1 PLO 5 PLO 20	Practical work 10	11th week
12.	Recursion properties	PLO 5 PLO 20	Practical work 11	12th week
13.	Sorting methods	PLO 1 PLO 5 PLO 20	Practical work 12	13th week
14.	Structures in C ++.	PLO 5 PLO 20	Practical work 13	14th week
15.	Classes in C ++.	PLO 5 PLO 20	Practical work 14, 15	15th week
16.	Modular control work	PLO 1 PLO 5 PLO 20	MCW	16th week
17.	Calculation and graphics work	PLO 1 PLO 5 PLO 20	Registration and submission of work	17th week
18.	Test	PLO 1 PLO 5 PLO 20	Test	18th week

6. Independent student work

One of the main types of semester control during the mastering of the discipline "Object-Oriented Programming" is the implementation of calculation and graphic work. Calculation and graphic work is performed in accordance with the requirements, within the period specified by the teacher.

The main purpose of computational and graphic work is to solve a practical problem using the material learned in lectures and independently, and practical skills acquired in practical work. The student can write calculation and graphic work only on the subject agreed with the teacher.

Approximate subject of calculation and graphic work:

1. Implement merge sorting of a one-dimensional array of a given size.

2. Create a program that implements the sorting of the array by the method of Shell (Shell Sort) two-dimensional data array of dimension n (i; j) = n [10; 10].

3. Write a program that compares the value of the norm and the deviation from the norm of human blood.

4. To develop four data sets (norm, increased and underestimated indicators, unknown value), where the physiological indicators of the cardiovascular system, which are fixed by the user, will be sorted.

5. Create a program that performs the function of ranking students in a group on two indicators by sorting "bubbles".

6. Create a program that performs the function of ranking students going to the general meeting. Sort by any method. The growth of students in the data set was entered automatically by the method of autocomplete one-dimensional data set.

The title page of the calculation and graphic work should have the following content: the name of the university; name of the faculty; name of department; name of specialty, name of educational-professional program, name of academic discipline; theme of calculation and graphic work; surname and name of the student, course, number of the academic group, year.

The title page is followed by a detailed plan (content) of the calculation and graphic work, which should highlight the introduction, sections of the main content (main topics studied), their subdivisions (if necessary), conclusion, list of sources used. The table of contents on the right indicates the page numbers at the beginning of each question. Each section begins on a new page.

The total amount of calculation and graphic work, depending on the chosen topic can vary from 15 to 20 pages of the main text (in consultation with the teacher).

Mandatory requirement: clear reference to sources of information. All figures, facts, opinions of scientists, quotations, formulas should have a reference in the form [2, p. 54] (the first digit means the number of the source in the list of references given at the end of the creative work, and the second digit - the page number in this source). It is desirable to use tables, diagrams, graphs, charts, etc. The list of used sources (not less than 10 sources) is made out according to operating rules. If the information is taken from the Internet, you need, as for ordinary literature, specify the author, the title of the article, and then provide the address of the site on the Internet.

Calculation and graphic work is evaluated by the following criteria: logic of the plan; completeness and depth of topic disclosure; reliability of the received data; reflection of practical materials and results of calculations; correctness of formulation of conclusions of the received results and conclusions; design; substantiation of the student's own opinion on this issue in the form of a conclusion.

Deadline for submission of calculation and graphic work for verification: 10 days before the test session.

Calculation and graphic work is not tested for plagiarism, but must meet the requirements of academic integrity. In case of academic dishonesty, the work is canceled and not checked.

Policy and control

7. Policy of academic discipline (educational component)

Attending classes

Attendance at lectures is not mandatory, but it is desirable, because there are no sources that cover the systematized educational material in sufficient to master the credit module and to perform calculation and graphic work. It is desirable to attend practical classes, because they discuss the material needed for practical work and RGR, the teacher demonstrates many subtleties and features of creating programs using Python, which cannot be covered during lectures, as well as the defense of practical work..

The grading system is focused on obtaining points for student activity, as well as performing tasks that are able to develop practical skills and abilities.

Control measures missed

Missed control measures (defense of practical work) must be practiced in the next classes, provided that the task is scheduled for the current lesson, or in consultations.

Omissions of writing a module test and express test are not fulfilled.

Calculation and graphic work, which is submitted for inspection in violation of the deadline is evaluated with a decrease in the number of weight points.

Violation of deadlines and incentive points

Encouragement points		*Penalty points **	
Criterion	*Weight points*	*Criterion*	*Weight points*
Improving practical work	*1 points (for each practical work)*	*Untimely implementation and test of practical work*	*From -0.5 points to -3 points (depending on the delivery date)*
Passing distance courses on topics that are agreed with teachers	*5 points*	*Untimely execution and test of calculation and graphic work*	*From -2 points to -16 points (depending on the construction period)*
Registration of scientific work for participation in the competition of student scientific works	*10 points*		
Writing abstracts, articles, participation in international, national and / or other events or competitions on the subject of the discipline	*5 points*		

** if the control measure was missed for a good reason (illness, which is confirmed by a certificate of the established sample) - penalty points are not accrued.*

Academic integrity

The policy and principles of academic integrity are defined in Section 3 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: https://kpi.ua/code.

Norms of ethical behavior

Normative principles of behavior of students and employees, defined in sections 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: https://kpi.ua/code.

Procedure for appealing the results of control measures

Students have the opportunity to raise any issue related to the control procedure and expect it to be addressed according to predefined procedures.

The student has the right to appeal the results of the control measure according to the approved provision on appeals in the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (approved by the order №NON/128/2021 from 20.05.2021) - https://osvita.kpi.ua/index.php/node/182

Inclusive education

The discipline "Object-Oriented Programming" can be taught to most students with special educational needs, except for students with severe visual impairments who do not allow to perform tasks using personal computers, laptops and / or other technical means.

Distance learning

Distance learning takes place through the Sikorsky Distance learning Platform «Sikorsky».

Distance learning through additional online courses on certain topics is allowed subject to agreement with students. If a small number of students wish to take an online course on a specific topic, studying the material with such courses is allowed, but students must complete all the tasks provided in the discipline.

The list of courses is offered by the teacher after the students have expressed a desire (because the bank of available courses is updated almost every month).

The student provides a document confirming the completion of the distance course (in the case of a full course) or provides practical tasks from the distance course and subject to an oral interview with the teacher on the topics can receive grades for control measures provided for the studied topics (express control / test tasks, practical work).

Performance of practical works, and also performance of settlement and graphic work, is carried out during independent work of students in a remote mode (with a possibility of consultation with the teacher through e-mail, social networks).

Learning a foreign language

Teaching in English is carried out only for foreign students.

At the request of students, it is allowed to study the material with the help of English-language online courses on topics that correspond to the topics of specific classes.

8. Monitor and evaluate the system of evaluation of learning outcomes (Rating System of Evaluation)

Evaluation system (current control):

1. *Spring semester, 5.5 ECTS credits / 165 hours*

№ s/n	Control measure	%	Weight points	Number	Total
2.	Execution and test of practical works	60	4	15	60
4.	Modular control work (MCW)	20	20	1	20
5.	Calculation and graphic work (CGW)	20	20	1	20
6.	Test work[1]	80	80	1	80
	Total				100

[1]*Accounted for in the amount of the rating together with the grade for CGW if the student has not scored 60 points per semester or he wants to improve his grade.*

The applicant receives a positive credit score for the results of the semester, if he has a final rating for the semester of at least 60 points and has met the conditions of admission to the semester control, which are determined by the RSE (Rating System of Evaluation).

With applicants who have met all the conditions of admission to the test and have a rating of less than 60 points, as well as with those applicants who want to increase their rating, in the last scheduled lesson in the semester, the teacher conducts semester control in the form of test or interviews.

After performing the test, if the score for the test is higher than the rating, the applicant receives a score based on the results of the test.

If the grade for the test is lower than the rating, a "hard" RSE is used - the previous rating of the applicant (except for points for the semester individual task) is canceled and he receives a grade based on the results of the test. This option forms a responsible attitude of the applicant to the decision to perform the test, forces him to critically assess the level of his training and carefully prepare for the test.

Calendar control *(CC) - is performed twice a semester as monitoring of the current state of compliance with syllabus requirements.*

The purpose of calendar control is to improve the quality of student learning and monitor the implementation of the schedule of the educational process by students.

Criterion			The first CC	The second CC
Deadline of calendar controls			8th week	14th week
Conditions for obtaining a positive result from the calendar control	Current rating		≥ 15 points	≥ 40 points
	Execution practical work	PW № 1- 7	+	+
		PW № 8-15	-	+
	Modular control work	Estimated MCW	-	+
	Calculation and graphic work	Estimated CGW	-	-

In case of detection of academic poor quality during training - the control measure is not credited.

Semester certification of students

Mandatory condition for admission to the test		Criterion
1	Current rating	RD ≥ 42
2	Obtaining a positive assessment for the performed calculation and graphic work	not less than 60% of the maximum score
3	All practical works are tested	More than 14 points
4	Modular control work	not less than 60% of the maximum score

The results are announced to each student separately in the presence or remotely (by e-mail). Also recorded in the system "Electronic Campus".

Optional conditions for admission to closure:

1. *Activity in practical classes.*
2. *Positive result of the first attestation and the second attestation.*
3. *Attending of lectures.*

Table of translation of rating points to grades on a university scale:

Number points	Assessment on the university scale
100-95	Perfectly / Відмінно
94-85	Very good / Дуже добре
84-75	Good / Добре
74-65	Satisfactorily / Задовільно
64-60	Enough / Достатньо
Less 60	Unsatisfactorily / Незадовільно
Admission conditions are not met	Not allowed / Не допущено

9. Additional information on the discipline (educational component)

The list of questions for preparation for modular control work, and also for preparation for credit is given in appendix 1.

Distance learning through additional online courses on certain topics is allowed subject to agreement with students. If a small number of students wish to take an online course on a specific topic, studying the material with such courses is allowed, but students must complete all the tasks provided in the discipline.

The list of courses is offered by the teacher after the students have expressed a desire (because the bank of available courses is updated almost every month).

The student provides a document confirming the completion of the distance course (in the case of a full course) or provides practical tasks from the distance course and subject to an oral interview with the teacher on the topics can receive grades for control measures provided for the studied topics (express control / test tasks, practical work).

Work program of the discipline (syllabus):

Compiled by *Associate Professor of Biomedical Engineering, Doctor of Technical Sciences, Shlykov Vladyslav Valentynovych, Head of the Department of Biomedical Engineering.*

Approved by *the Department of Biomedical Engineering (protocol № 16 of June 21, 2024)*

Approved by *the Methodical Commission of the Faculty of Biomedical Engineering (protocol № 9 of June 26, 2024)*

Appendix 1 to the syllabus of the discipline

"Object-Oriented Programming"

The list of questions for preparation for modular control work,

And also for preparation for test

1. *Explain what is OOP?*
2. *Explain the properties and principles of OOP.*
3. *What Is The Difference Between C And C++ ?*
4. *What is the basic structure of a C++ program?*
5. *What are the Comments in C++?*
6. *Difference between Declaration and Definition of a variable.*
7. *What is a Constant? Explain with an example.*
8. *What is the difference between equal to (==) and Assignment Operator (=)?*
9. *What are the various Arithmetic Operators in C++?*
10. *What are the various Compound Assignment Operators in C++?*
11. *What are the Extraction and Insertion operators in C++? Explain with examples*
12. *Give the generic for loop syntax.*
13. *What variable is called a loop counter?*
14. *What is the purpose of the operator break?*
15. *What is the purpose of the goto operator?*
16. *What is the purpose of the operator continue?*
17. *What is called nested loops?*
18. *What is the difference between while and do while loop? Explain with examples.*
19. *What is called an array?*
20. *What is the index of an array element?*
21. *How can you access the array elements?*
22. *What is the function?*
23. *How to declare functions?*
24. *How to define functions?*
25. *What is called the body function?*
26. *What is called a list of parameters of the function?*
27. *What parameters are called actual?*
28. *What parameters are called formal?*
29. *What are the prototype functions?*
30. *What is the purpose of the return operator?*
31. *What do you mean by 'void' return type?*
32. *What are Default Parameters? How are they evaluated in C++ function?*
33. *What is a structure?*
34. *What are the variables that are part of the structure called?*
35. *What keyword is used to define a structure?*
36. *Give an example of structure.*
37. *How to access structural elements?*
38. *What is the difference between struct and class in C++?*
39. *What is a class?*
40. *How to define a new class?*
41. *Give the general format of the class declaration.*
42. *Explain the principle of data encapsulation.*
43. *What levels of access to class members do you know?*
44. *What is the difference between open and closed class members?*

45. *How to define objects of a class?*
46. *What is the mechanism of inheritance?*
47. *How to generate one class from another?*
48. *What is the name of the class that generates other classes?*
49. *What is the name of a class that is a descendant of another class?*
50. *What is the case of creating a class based on two or more classes?*