

# Architecture and Design of Software

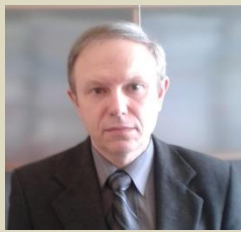
## COURSE SYLLABUS

<b>Code and name of specialty</b>	122 – Computer Science	<b>Institute / faculty</b>	Faculty of Computer Science and Software Engineering
<b>Program name</b>	«Computer Science and Intelligent Systems»	<b>Department</b>	Software Engineering and Management Information Technologies
<b>Type of program</b>	<b>Educational and Professional</b>	<b>Language of instruction</b>	Ukrainian

### LECTURER

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**Ph.D., Associate Professor, Associate Professor of Software Engineering and Information Technology Management. Prepared and published more than 100 research papers and textbooks. (<https://scholar.google.com/citations?user=bvEPOtYAAAAJ&hl=ru>, <https://www2.scopus.com/authid/detail.uri?authorId=57202894400>, <https://orcid.org/0000-0002-8261-2988>).**

**Leading lecturer of courses:** *DataBases (in Ukrainian), Architecture and Design of Software (in Ukrainian), Enterprise Architecture Management (in Ukrainian), IT-infrastructure (in Ukrainian), Modeling and Analysis of Business-Processes (in Ukrainian), DataBases and DataWareHouses (in Ukrainian), BI-technologies (in Ukrainian).*

### GENERAL DESCRIPTION OF THE COURSE

<b>Summary</b>	<p>The course “Architecture and Design of Software” is a course in the cycle of professional compulsory training of the specialty 122 “Computer Science”. It is taught in two parts in 5 and 6 semesters in the amount of 240 hours (8 ECTS credits), in particular: lectures – 64 hours, laboratory classes – 64 hours, independent work – 112 hours. Individual task is a course work. The study of the discipline ends with the exam.</p> <p>The subject of study of the discipline are the main aspects of theory and practice in the field of design, development, implementation, maintenance and operation of software information systems, the use of hardware and software for processing economic and other information.</p>
<b>Course objectives</b>	The purpose of studying the discipline is the formation of specialists in information systems and technologies of theoretical knowledge and practical skills in the basics of design, development, implementation, maintenance and operation of information systems software.
<b>Types of classes and control</b>	Lectures, laboratory classes. Continuous assessment – laboratory works, intermediate modular assessment. Final assessment – exam.
<b>Term</b>	5,6

<b>Student workload (credits) / Type of course</b>	8/ Mandatory	<b>Lectures (hours)</b>	64	<b>Laboratory classes (hours)</b>	64	<b>Self-study (hours)</b>	112
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<b>Program competences</b>	<p>GC1. Ability to abstract thinking, analysis and synthesis.</p> <p>GC2. Ability to apply knowledge in practical situations.</p> <p>GC3. Knowledge and understanding of the subject area and understanding of professional activity.</p> <p>GC6. Ability to learn and master modern knowledge.</p> <p>GC9. Ability to work in team.</p>
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PC8. Ability to design and develop software using different programming paradigms: generalized, object-oriented, functional, logical, with appropriate models, methods and algorithms of calculations, data structures and management mechanisms.

PC9. Ability to implement a multi-tier computing model based on the client-server architecture, including databases, knowledge bases, and data warehouses, perform distributed processing of large data sets on clusters of standard servers to meet the computing needs of users, including cloud services.

PC10. Ability to apply methodologies, technologies, and tools to manage the life cycle processes of information and software systems, information technology products and services according to customer requirements.

PC12. Ability to ensure the organization of computational processes in information systems of various purposes, taking into account the architecture, configuration, performance indicators of operating systems and system software.

PC19. Ability to comprehensively use for the creation of intelligent management systems methods of mathematical modelling and analysis of complex systems, methods of modelling and analysis of business processes, information technologies for the management of business systems.

PC20. Ability to develop the architecture of software systems and their particular components during the design of intelligent management systems in various fields, to manage the life cycle of intelligent management systems software.

Learning outcomes	Teaching and learning methods	Forms of assessment (continuous assessment CAS, final assessment FAS)
<p>PLO9. Develop software models of subject areas, choose a programming paradigm from the standpoint of convenience and quality of its application to implement methods and algorithms that solve problems in the computer science field.</p>	<p>Interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback method, problem-based learning</p>	<p>Written individual assignments for laboratory works (CAS), assessment of knowledge in laboratory classes (CAS), express surveys (CAS), online tests (CAS), final/semester control in the form of a semester exam, according to the schedule of the educational process (FAS)</p>
<p>PLO10. Use tools for developing client-server applications, design conceptual, logical, and physical models of databases, develop and optimize database queries, create distributed databases, repositories and showcases of databases, and knowledge bases, including those based on cloud services, using web programming languages.</p>	<p>Interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback method, problem-based learning</p>	<p>Written individual assignments for laboratory works (CAS), assessment of knowledge in laboratory classes (CAS), express surveys (CAS), online tests (CAS), final/semester control in the form of a semester exam, according to the schedule of the educational process (FAS)</p>
<p>PLO11. Have the skills to manage the life cycle of software, products, and services of information technology under the requirements and restrictions of the customer, be able to develop project documentation (feasibility study, technical task, business plan, agreement, contract).</p>	<p>Interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback method, problem-based learning</p>	<p>Written individual assignments for laboratory works (CAS), assessment of knowledge in laboratory classes (CAS), express surveys (CAS), online tests (CAS), final/semester control in the form of a semester exam, according to the schedule of the educational process (FAS)</p>
<p>PLO19. Create intelligent management systems using methods of mathematical modelling and analysis of complex systems, methods of modelling and analysis of business processes, information technologies for the management of business systems.</p>	<p>Interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback method, problem-based learning</p>	<p>Written individual assignments for laboratory works (CAS), assessment of knowledge in laboratory classes (CAS), express surveys (CAS), online tests (CAS), final/semester control in the form of a semester exam, according to the schedule of the educational process (FAS)</p>

PLO20. Develop the architecture of software systems and their particular components during the construction of intelligent management systems in various fields, as well as manage the life cycle of intelligent management systems software.

Interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback method, problem-based learning

Written individual assignments for laboratory works (CAS), assessment of knowledge in laboratory classes (CAS), express surveys (CAS), online tests (CAS), final/semester control in the form of a semester exam, according to the schedule of the educational process (FAS)

**ASSESSMENT AND GRADING**

Range s of points corres pondi ng to grades	Total score (points) for all types of learning activities	ECTS grading scale	The national grading scale	Allocation of grade points
	90-100	A	excellent	
	82-89	B	good	
	74-81	C		
	64-73	D	satisfactory	
	60-63	E		
	35-59	FX	Unsatisfactory (with the exam retake option)	
	0-34	F	Unsatisfactory (with mandatory repetition of the course)	

**Part 1**  
**100% Final assessment** as a result of Final exam (30%) and Continuous assessment (70%).  
**30% Final exam**  
**70% Continuous assessment:**  
 Module №1 (10%)  
 Module №2 (20%)  
 Laboratory works (40%)  
**Part 2**  
**100% Final assessment** as a result of Final exam (30%) and Continuous assessment (70%).  
**30% Final exam**  
**70% Continuous assessment:**  
 Module №1 (10%)  
 Module №2 (10%)  
 Laboratory works (20%)  
 Course work (30%)

**Course policy** Students must attend all classes according to the study schedule and adhere to the norms of academic ethics. To study the course, students need to have their personal computer and (or) use computers of the computer center at the department. Students must work with compulsory and recommended reading, including Internet resources. Students must complete and submit all laboratory works during the semester in which the course is taught, before the examination session. The final assessment is not carried out without the personal presence of students.

## COURSE STRUCTURE AND CONTENT

### Part 1

<b>Topic 1</b>	Information system software life cycle		Innovation Campus: PT18 –Web Fullstack – chronos	<b>Self-study</b>	Life cycle models
<b>Topic 2</b>	Methodologies of designing and developing software of information systems		Innovation Campus: PT18 –Web Fullstack – chronos		Features of practical application of software design and development methodologies
<b>Topic 3</b>	Business modeling	<b>Laboratory work 1</b>	Development of IDEF0 models Innovation Campus: PT55 –ASD – Sprint01		Modeling of business processes with the support of modern CASE-tools Requirements management tools Prototyping tools Documentation of software requirements
<b>Topic 4</b>	Information system software requirements	<b>Laboratory work 2</b>	Development of IDEF3 models Innovation Campus: PT18 –Web Fullstack – chronos PT19 –Web Fullstack – uevent		
		<b>Laboratory work 3</b>	Development of DFD models Innovation Campus: PT18 –Web Fullstack – chronos PT19 –Web Fullstack – uevent		
<b>Topic 5</b>		Information system software design	<b>Laboratory work 4</b>		Development of a database as a component of an information system (on the example of MySQL database) Innovation Campus: PT19 –Web Fullstack – uevent
<b>Topic 6</b>	Practical aspects of information system software design	<b>Laboratory work 5</b>	Development of data manipulation tools and tools to support business logic requirements Innovation Campus: PT19 –Web Fullstack – uevent		Substantiation of the choice of DBMS and tools for application software development
		<b>Laboratory work 6</b>	Development of data integrity control tools and transaction management tools Innovation Campus: PT19 –Web Fullstack – uevent		
		<b>Laboratory work 7</b>	Development of user management tools Innovation Campus: PT19 –Web Fullstack – uevent		

**Laboratory work 8**  
 Development of a client application (on the example of MySQL database and PHP language  
 Innovation Campus:  
 PT19 –Web Fullstack – uevent

**Part 2**

<b>Topic 1</b>	Construction of information system software	<b>Laboratory work 1</b>	Familiarity with the Archi tool and the Archimate modeling language Innovation Campus: PT18 –Web Fullstack – chronos PT20 –Web Fullstack – webster PT56 –ASD – Sprint02 PT57 –ASD – Sprint03	<b>Self-study</b>	Software construction support tools End user interface. Features of user interface design and development
		<b>Laboratory work 2</b>	Construction of Archimate-models of information systems architecture and technical infrastructure Innovation Campus: PT18 –Web Fullstack – chronos PT20 –Web Fullstack – webster PT56 –ASD – Sprint02 PT57 –ASD – Sprint03		
		<b>Laboratory work 3</b>	Reconstruction of models of information systems architecture and technical infrastructure Innovation Campus: PT18 –Web Fullstack – chronos PT20 –Web Fullstack – webster PT56 –ASD – Sprint02 PT57 –ASD – Sprint03		

		<b>Laboratory work 4</b>	Documentation of requirements and design of information system architecture using UML language Innovation Campus: PT18 –Web Fullstack – chronos PT20 –Web Fullstack – webster PT56 –ASD – Sprint02 PT57 –ASD – Sprint03	
<b>Topic 2</b>	Information system software testing	<b>Laboratory work 5</b>	Creating a WEB-application using the BOOTSTRAP framework. Using AJAX technology for asynchronous data exchange with a WEB server Innovation Campus: PT18 –Web Fullstack – chronos PT20 –Web Fullstack – webster	Software testing systems, their tasks and functions
<b>Topic 3</b>	Implementation, support and maintenance of information system software		Innovation Campus: PT18 –Web Fullstack – chronos PT20 –Web Fullstack – webster	The main problems related to the implementation, support and maintenance of software
<b>Topic 4</b>	Organization of information system software design and development		Innovation Campus: PT18 –Web Fullstack – chronos PT20 –Web Fullstack – webster	The team of information system developers. Features of team building and management Features of IT project management
<b>Topic 5</b>	Configuration management	<b>Laboratory work 6</b>	Familiarity with the distributed GIT version control system Innovation Campus: PT19 –Web Fullstack – uevent PT20 –Web Fullstack – webster	Configuration management systems, their tasks and functions
		<b>Laboratory work 7</b>	Working with branches in the GIT system Innovation Campus: PT19 –Web Fullstack – uevent PT20 –Web Fullstack – webster	
<b>Topic 6</b>	Operation of information system software		Innovation Campus: PT19 –Web Fullstack – uevent PT20 –Web Fullstack – webster	Methods and tools to support the operation of software

## RECOMMENDED READING

### Compulsory

- 1 Орловський Д.Л. (2018) Бізнес-процеси підприємства: моделювання, аналіз, удосконалення : Частина 1. Моделювання бізнес-процесів: методи та засоби Харків : НТУ «ХПІ».
- 2 Орловський Д.Л. (2018) Бізнес-процеси підприємства: моделювання, аналіз, удосконалення : Частина 2. Бізнес-процеси: аналіз, управління, удосконалення Харків : НТУ «ХПІ».
- 3 Pethuru Raj, Anupama Raman, Harihara Subramanian. (2017) Architectural Patterns. Uncover essential patterns in the most indispensable realm of enterprise architecture Packt Publishing,
- 4 Blair Reeves and Benjamin Gaines. (2018) Building Products for the Enterprise. Product Management in Enterprise Software.
- 5 Phillip A. Laplante. (2018) Requirements engineering for software and systems CRC Press,
- 6 Fred Heath. Managing Software Requirements the Agile Way. (2020) Packt Publishing,
- 7 Charles Tatum. THE ART AND SCIENCE OF SOFTWARE DEVELOPMENT. (2020.) Winthrop Publishers.
- 8 Gabriel Baptista, Francesco Abbruzzese. Software Architecture with C# 9 and .NET 5. Second Edition.(2020) Packt Publishing,
- 9 Roger S. Pressman, Bruce R. Maxim.(2020) SOFTWARE ENGINEERING: A PRACTITIONER'S APPROACH. McGraw-Hill Education.
- 10 Umesh Kumar Tiwari, Santosh Kumar. (2021) Component-Based Software Engineering. Methods and Metrics. Taylor & Francis Group, LLC
- 11 Boyd L. (2021) Summers. Effective Methods for Software Engineering. – Taylor & Francis Group, LLC.
- 12 Fabio Cicerchia. (2021) 10 Software Engineer. Curated contents for software engineers. Lean Publishing.
- 13 Murat Erder, (2021) Pierre Pureur, Eoin Woods. Continuous Architecture in Practice. Software Architecture in the Age of Agility and DevOps. Pearson Education.
- 14 Jocelyn O. (2021) Padallan. Distributed Database Architecture. Arcler Press.

### Recommended

- 15 Scott A. (2021) Whitmire. Engineer Your Software! Morgan & Claypool Publishers,– 145 p.
- 16 Neal Ford, Mark Richards, Pramod Sadalage, Zhamak Dehghan. Software Architecture: The Hard Parts. (2021) O'Reilly Media, 17 Thomas Kilian. Inside Enterprise Architect. Lean Publishing.
- 18 Paul Beynon-Davies. (2020) BUSINESS INFORMATION SYSTEMS. THIRD EDITION. – Red Globe Press,
- 19 Capers Jones.(2021) Software Development Patterns and Antipatterns. CRC Press.
- 20 Joseph Ingeno. (2018) Software Architect's Handbook. Packt Publishing.
- 21 Cristian Bojinca. (2017) How to Become an IT Architect ARTECH HOUSE.
- 22 Frank M. Kromann. (2018) Beginning PHP and MySQL: From Novice to Professional. APRESS.
- 23 Stair R., Reynolds G. (2014) Fundamentals of Information Systems, Eighth Edition. – Boston, Cengage Learning.
- 24 Philippe Desfray, Gilbert Raymond. (2014) Modeling Enterprise Architecture with TOGAF®. A Practical Guide Using UML and BPMN. – Elsevier Inc.
- 25 IEEE Std 1320.1-1998. IEEE Standard for Functional Modeling Language Syntax and Semantics for IDEF0. (1998) New York: IEEE,
- 26 Mayer R.J., Menzel C.P., Painter, M.K., DeWitte, P.S. (1995) Information Integration For Concurrent Engineering (IICE). IDEF3 Process Description Capture Method Report College Station: KBSI.
- 27 John D. (2019) McDowall, Complex Enterprise Architecture: A New Adaptive Systems Approach. APRESS.
- 28 Carola Lilienthal. (2020) Sustainable Software Architecture. Analyze and Reduce Technical Debt. dpunkt.verlag,
- 29 Daniel Heller. Building a Career in Software: A Comprehensive Guide to Success in the Software Industry. APRESS
- 30 Орловский, Д.Л., Рубин Э.Е. (2012) Методические указания по выполнению расчетно-графического задания по теме «Использование стандартов IDEF0, IDEF3, DFD для моделирования бизнес-процессов» для студентов, обучающихся по направлениям «Компьютерные науки», «Программная инженерия», «Экономика», «Менеджмент» Харьков : НТУ «ХПІ».
- 30 Методичні вказівки для виконання курсової роботи Retrieved from: [https://iiii-my.sharepoint.com/personal/dmytro\\_orlovskiy\\_khpi\\_edu\\_ua/\\_layouts/15/onedrive.aspx?id=%2Fpersonal%2Fdmytro%5Forlovskiy%5Fkhp%5Fedu%5Fua%2FDocuments%2FD0%9FD1%80%D0%B0%D0%BA%D1%82%D0%B8%D1%87%D0%BD%D0%B8%D0%B9%20%D1%81%D0%B5%D0%BC%D1%96%D0%BD%D0%B0%D1%80%20%D0%B7%20%D0%BF%D1%80%D0%BE%D0%B5%D0%BA%D1%82%D1%83%D0%B2%D0%B0%D0%BD%D0%BD%D1%8F%20%D0%9F%D0%97](https://iiii-my.sharepoint.com/personal/dmytro_orlovskiy_khpi_edu_ua/_layouts/15/onedrive.aspx?id=%2Fpersonal%2Fdmytro%5Forlovskiy%5Fkhp%5Fedu%5Fua%2FDocuments%2FD0%9FD1%80%D0%B0%D0%BA%D1%82%D0%B8%D1%87%D0%BD%D0%B8%D0%B9%20%D1%81%D0%B5%D0%BC%D1%96%D0%BD%D0%B0%D1%80%20%D0%B7%20%D0%BF%D1%80%D0%BE%D0%B5%D0%BA%D1%82%D1%83%D0%B2%D0%B0%D0%BD%D0%BD%D1%8F%20%D0%9F%D0%97)

### Academic integrity

Students must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to show discipline, politeness, friendliness, honesty, responsibility

The content of this syllabus is consistent with the course program.