Syllabus
Course Program

Architecture and Design of Software

Specialty
122 – Computer Science

Institute
Institute of Computer Science and Information Technology

Educational program
Computer Science and Intelligent Systems

Department
Software Engineering and Management Intelligent Technologies (321)

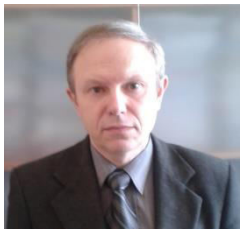
Level of education
Bachelor's level

Course type
Special (professional), Mandatory

Semester
5,6

Language of instruction
English, Ukrainian

Lecturers and course developers



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Ph.D., Associate Professor, Associate Professor of Software Engineering and Management Intelligent Technologies Department

Number of publications - more than 100.
Google Scholar:https://scholar.google.com/citations?user=bvEPOtYAAAAJ&hl
ORCID: https://orcid.org/0000-0002-8261-2988
Scopus: https://www2.scopus.com/authid/detail.uri?authorId=57202894400

More about the lecturer on the department's website

General information

Summary

The subject of study of the discipline is 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

Course objectives and goals

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.

Format of classes

Lectures, laboratory classes, consultations, self-study. Final control in the form of an exam.

Competencies

GC1. Ability to think abstractly, analyze and synthesize.
GC2. Ability to apply knowledge in practical situations.
GC3. Knowledge and understanding of the subject area and understanding of professional activities.

GC6. Ability to learn and master modern knowledge.
GC9. Ability to work in a team.
PC8. Ability to design and develop software using various programming paradigms: generalized, object-oriented, functional, logical, with appropriate models, methods and algorithms of computation, data structures and control mechanisms.
PC9. Ability to implement a multi-level computing model based on client-server architecture, including databases, knowledge and data warehouses, to 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 in accordance with customer requirements.
PC12. Ability to ensure the organization of computing processes in information systems for various purposes, taking into account the architecture, configuration, performance indicators of operating systems and system software.
PC15. Ability to analyze and functional modeling of business processes, construction and practical application of functional models of organizational, economic, production and technical systems, methods of risk assessment of their design.
PC19. Ability to comprehensively use methods of mathematical modeling and analysis of complex systems, methods of modeling and analysis of business processes, information technology for managing business systems to create intelligent control systems.
PC20. Ability to develop the architecture of software systems and their individual components in the construction of intelligent control systems in various fields, to manage the life cycle processes of software of intelligent control systems.

Learning outcomes

PLO9. Develop software models of subject environments, choose a programming paradigm from the standpoint of convenience and quality of application for the implementation of methods and algorithms for solving problems in the field of computer science.
PLO10. To use tools for developing client-server applications, design conceptual, logical and physical models of databases, develop and optimize queries to them, create distributed databases, data warehouses and showcases, knowledge bases, including cloud services, using web programming languages.
PLO11. Have the skills to manage the life cycle of software, products and services of information technology in accordance with the requirements and restrictions of the customer, be able to develop project documentation (feasibility study, terms of reference, business plan, agreement, contract).
PLO19. To create intelligent management systems using methods of mathematical modeling and analysis of complex systems, methods of modeling and analysis of business processes, information technology management of business systems.
PLO20. Develop the architecture of software systems and their individual components in the construction of intelligent control systems in various industries, as well as manage the life cycle processes of software of intelligent control systems.

Student workload

The total volume of the course is 240 hours (8 ECTS credits): lectures - 48 hours, laboratory classes - 64 hours, self-study - 128 hours.

Course prerequisites

Algorithmization and programming
Fundamentals of Computer Science and Artificial Intelligence
DataBases
Object-oriented programming
Software quality, testing and support

Features of the course, teaching and learning methods, and technologies

Teaching and learning methods:
interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback, problem-based learning.

Forms of assessment:
written individual assignments for laboratory work (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).

Program of the course

Topics of the lectures

Semester 5
Topic 1 Information system software life cycle
Software as a component of the information system. The main components of information systems and their characteristics. The main stages of the life cycle, their relationship. Life cycle models.
Topic 2. Methodologies of designing and developing software of information systems
RUP methodology. Purpose and characteristics. RUP processes and phases. Flexible methodologies for designing and developing information systems (Agile, Scrum, etc.). SWEBOK (Software Engineering Body of Knowledge) methodology.
Topic 3. Business modeling
Purpose of business modeling. Overview of the main notations of modeling business systems and business processes. Functional modeling. IDEF0, IDEF3, DFD models, their purpose and features. Modeling business processes using modern CASE tools
Topic 4. Information system software requirements
Knowledge area SWEBOK "Software requirements". Levels of requirements. Classification of requirements. Requirements extraction techniques. Architectural design and allocation of requirements. Specifications of requirements, their composition and content. Requirements management tools, prototyping tools, documentation of software requirements
Topic 5. Information system software design
Knowledge area SWEBOK "Software design". General description of software architecture. The concept of CASE technologies. The UML language, its purpose and features. Patterns and their application in the design of information system software. Multi-layered architecture. Component architecture. Service-oriented architecture.
Topic 6. Practical aspects of information system software design (using the example of the MySQL DBMS and the PHP language)
Creation and application of database objects. Applied software development
Semester 6
Topic 1. Design and construction of information system software
Basic documents developed during the design and construction of software. Enterprise architecture and its relationship with software design, construction and development processes. Archimate modeling language. SWEBOK Knowledge Area "Software Construction". Software construction support tools.
Topic 2. Information system software testing
Knowledge area SWEBOK "Software Testing". Types and techniques of testing. Testing tools.
Topic 3. Implementation, support and maintenance of information system software
Basic documents related to putting information system software into operation. The main problems associated with the implementation of information systems, their classification and content. Software implementation methodologies. Knowledge area SWEBOK "Software support". Categories of support. Main support processes.
Topic 4. Organization of information system software design and development
IT projects, their main features. Basics of project management in the field of IT. A team engaged in the design, development and implementation of information system software. Peculiarities of team creation and management.
Topic 5. Configuration management
Knowledge area SWEBOK "Configuration management". Composition and content of the configuration management process. Identification and control of software configurations. Accounting for configuration statuses. Configuration audit. Production and delivery management. Means of configuration management. The Git system as an example of a configuration management tool.
Topic 6. Operation of information system software

The information system as a component of the IT infrastructure of the enterprise. The ITIL library, the ITSM approach and their application to solving IT infrastructure management problems. COBIT methodology - purpose, structure and main features. Management processes of the IT infrastructure of the enterprise. Cost of ownership (TCO) management of IT infrastructure. Relations between the developer and the user of the software. Software Licensing.

Topics of the workshops

Workshops are not provided within the discipline.

Topics of the laboratory classes

Semester 5
Topic 1. Development of IDEF0, IDEF3, DFD models
Topic 2. Development of a database as a component of an information system (on the example of DBMS MySQL)
Topic 3. Development of data manipulation tools and tools to support business logic requirements (on the example of DBMS MySQL)
Topic 4. Development of data integrity control tools and transaction management tools (on the example of DBMS MySQL)
Topic 5. Development of user management tools (on the example of DBMS MySQL)
Topic 6. Development of a client application (on the example of DBMS MySQL database and PHP language)
Semester 6
Topic 1. Familiarity with the Archi tool and the Archimate modeling language. Construction of Archimate-models of business architecture
Topic 2. Construction of Archimate-models of information systems architecture and technical infrastructure
Topic 3. Reconstruction of models of information systems architecture and technical infrastructure
Topic 4. Documentation of requirements and design of information system architecture using UML language
Topic 5. Creating a WEB-application using the BOOTSTRAP framework. Using AJAX technology for asynchronous data exchange with a WEB server
Topic 6. Familiarity with the distributed GIT version control system. Working with branches in the GIT system

Self-study

Semester 5
Individual assignments are not provided in the curriculum.
Students are recommended with additional materials (videos, articles) for self-study and processing.
Semester 6
The curriculum includes the completion of course project (CP). At the beginning of the semester, students choose the topics of the course project from the list or propose their own topics and agree them with the teacher. The CP is completed during the semester and is defended during the test week or examination session.
Students are recommended with additional materials (videos, articles) for self-study and processing.

Course materials and recommended reading

Key literature

1. Орловський Д.Л., Бізнес-процеси підприємства: моделювання, аналіз, удосконалення : навчальний посібник. Частина 1. Моделювання бізнес-процесів: методи та засоби, Харків : НТУ «ХПІ», 2018, 336 с.'
2. Орловський Д.Л., Бізнес-процеси підприємства: моделювання, аналіз, удосконалення : навчальний посібник. Частина 2. Бізнес-процеси: аналіз, управління, удосконалення, Харків : НТУ «ХПІ», 2018, 433 с.

3. N. Ford, M. Richards, Fundamentals of Software Architecture: A Comprehensive Guide to Patterns, Characteristics, and Best Practices, O'Reilly Media, 2020, 500 p.
4. F. Heath, Managing Software Requirements, the Agile Way, Packt Publishing, 2020, 214 p.
5. M. Erder, P. Pureur, E. Woods. Continuous Architecture in Practice. Software Architecture in the Age of Agility and DevOps, Pearson Education, 2021, 353 p.

Additional literature

1. N. Ford, M. Richards, P. Sadalage, Z. Dehghan, Software Architecture: The Hard Parts, O'Reilly Media, 2021, 462 p.
2. J. Ingeno, Software Architect's Handbook, Packt Publishing, 2018, 584 p.
3. J. D. McDowall, Complex Enterprise Architecture: A New Adaptive Systems Approach, APRESS, 2019, 164 p.
4. T. Mariot, Beginning Git and GitHub, APRESS, 2020, 294 p.
5. U. K. Tiwari, S. Kumar, Component-Based Software Engineering. Methods and Metrics, Taylor & Francis Group, LLC, 2021, 226 p.

Assessment and grading

Criteria for assessment of student performance, and the final score structure

Description of the final score structure, course requirements, and necessary steps to earn points, especially paying attention to self-study and individual assignments.

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.
Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Approval

Approved by	08.06.2023	Head of the department Ihor HAMAIUN
	08.06.2023	Guarantor of the educational program Andrii KOPP