**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE**
**Lesya Ukrainka Volyn National University**
**Faculty of Information Technologies and Mathematics**
**Department of Computer Science and Cybersecurity**

# SYLLABUS
**Normative Educational Component**
# SOFTWARE TESTING AND MAINTENANCE
**Preparations at the Second (Master's) Level of Higher Education**
**Specialty: 122 Computer Science**
**Educational (Professional) Program: Computer Science and Information Technologies**

Lutsk – 2023

**Syllabus of the educational component** «Software Testing and Maintenance» for Master's level training, field of knowledge 12 Information Technology, specialization 122 Computer Science, within the educational program Computer Science and Information Technology.

**Developer:** Ia.M. Pasternak, Professor of the Department of Computer Science and Cybersecurity, DSc, Prof.

**Approved by**
Program Educational Guarantor: Bulatetskyy V.V.

**The syllabus of the educational component was approved at the meeting of the Department of Computer Science and Cybersecurity**

protocol No.1 of 30.08.2023

Head of the department: (Hryshanovych T.O.)

## I. Description of the educational component

| **Name of indicators** | **Field of knowledge, specialty, educational-professional** /educational-scientific/educational-creative **program, educational level** | **Characteristic educational component** |
|---|---|---|
| **Full-time form of education** | 12 Information Technologies,<br>122 Computer Science,<br>Computer Science and Information Technology,<br>second (master's) | **Normative** |
| | | **Year of study** – 1st |
| **Number of hours/credits** 120/4 | | **Semester** – 1st |
| | | **Lectures** – 14 hours |
| **IERT**: 1 | | **Laboratory** – 20 hours |
| | | **Independent work** – 78 hours |
| | | **Consultations** – 8 hours |
| | | **Form of control**: exam |
| **Language of education** – English, Ukrainian | | |

## II. Information about the instructor

**PIP:** Pasternak Iaroslav Mykhailovych
**Degree:** DSc
**Academic status:** Professor
**Position:** professor of the Department of Computer Science and Cybersecurity
**Contact Information:** Iaroslav.Pasternak@vnu.edu.ua
**Days of classes:** http://94.130.69.82/cgi-bin/timetable.cgi

## III. Description of the educational component

1. **Abstract of the course**

   The course covers the basics of software testing and maintenance. The presentation concerns both general theory and applied aspects of its use by developers.

2. **Prerequisite (*previous courses on which the study of the educational component is based*)**

   Bachelor's level of higher education.

   EC8. Design and Development Technologies of Web Resources.

   EC9. Software Architecture.

   EC14. Practice on Software Design.

3. **The purpose and tasks of the educational component**

   Development of competences in assessing the quality of information and computer systems, software testing and support.

4. **Learning outcomes (Competencies)**

   *Learning outcomes:*

   LO2. Have specialized computer science problem-solving skills necessary for conducting research and/or conducting innovative activities to develop new knowledge and procedures.

   LO13. Assess and ensure the quality of information and computer systems for various purposes.

   LO14. Test the software.

LO19. To analyze the current state and global trends in the development of computer sciences and information technologies.

*Competencies:*

GC01. Ability to abstract thinking, analysis and synthesis.

GC02. Ability to apply knowledge in practical situations.

GC04. Ability to communicate in a foreign language.

GC05. Ability to learn and master modern knowledge.

GC07. Ability to generate new ideas (creativity).

SC01. Understanding the theoretical foundations of computer science.

SC02. The ability to formalize the subject area of a certain project in the form of an appropriate information model.

SC07. Ability to develop software according to formulated requirements, taking into account available resources and constraints.

SC10. The ability to evaluate and ensure the quality of IT projects, information and computer systems of various purposes, to apply international standards for assessing the quality of software of information and computer systems, models for assessing the maturity of information and computer systems development processes.

SC11. The ability to initiate, plan and implement the development processes of information and computer systems and software, including its development, analysis, testing, system integration, implementation and support.

5. **The structure of the educational component**

| **Names of content modules and topics** | **Total** | **Lec.** | **Lab.** | **IW** | **Cons.** | **Control form/ Points** |
|---|---|---|---|---|---|---|
| **Content module 1. General issues of software testing** | | | | | | |
| Topic 1. Basic issues of software quality. Fundamentals of software engineering | 13 | 2 | 2 | 8 | 1 | DS, SP/C<br>3 |
| Topic 2: Fundamentals of software testing. Static testing | 15 | 2 | 2 | 10 | 1 | DS, SP/C<br>4 |
| Topic 3. Test planning. Analysis and development of test cases. | 17 | 2 | 4 | 10 | 1 | DS, SP/C<br>4 |
| Topic 4. Organization and implementation of the testing process. Outsourcing testing | 13 | 0 | 2 | 10 | 1 | DS, SP/C<br>4 |
| Module 1 Total | 58 | 6 | 10 | 38 | 4 | 15 |
| **Content module 2. Scientific principles of software quality assurance** | | | | | | |
| Topic 5. Test metrics and evidence-based testing methods. Software testing tools. Tools and models for improving testing processes | 17 | 2 | 4 | 10 | 1 | DS, SP/C<br>4 |
| Topic 6. Software testing with agile development concepts. | 15 | 2 | 2 | 10 | 1 | DS, SP/C<br>4 |
| Topic 7. Testing security-sensitive systems | 15 | 2 | 2 | 10 | 1 | DS, SP/C<br>4 |
| Topic 8: Legal, Ethical and Professional Aspects of Software Testing and Maintenance. Management of versions and configurations of software products. | 15 | 2 | 2 | 10 | 1 | DS, SP/C<br>3 |
| Module 2 Total | 62 | 8 | 10 | 40 | 4 | 15 |

| **Types of final works** | | | | | | Points |
|---|---|---|---|---|---|---|
| Modular control work 1 | | | | | | 30 |
| Modular control work 2 | | | | | | 30 |
| IERT | | | | | | 10 |
| **Total hours/Points** | 120 | 14 | 20 | 78 | 8 | 100 |

Control methods*: DS – discussion, SP/C – solving problems/cases, IERT – individual task, MCW – modular control work.

**Tasks for independent study**

1. Development of free software. Software management and testing at the Free Software Foundation.
2. GNU GPL License
3. Selenium for testing web applications.
4. Models of software development process.

**Examples of individual tasks**

1. ***Risk analysis and assessment***. Suppose you need to work on a web application development project. Identify the potential risks associated with this type of project and develop an action plan to manage those risks.
2. ***Developing a test plan***. It is necessary to test the mobile application for certain functions. Create a detailed test plan, including the test strategy, the amount of resources required to run the tests, and the acceptance criteria.
3. ***Development of automated tests***. A website with a large number of pages needs to be tested. Create a suite of automated tests using a suitable testing framework.
4. ***Compatibility testing***. You should test the web application on different operating systems and/or browsers. Create a compatibility matrix and test on different configurations.
5. ***Security testing***. The web application must be tested for vulnerabilities. Analyze potential threats and make recommendations for improving application security.
6. ***Testing in the development process***. Set up a continuous integration and deployment process for the project (using the qualification work example). Ensure automatic execution of tests for every source code change and integration of reporting tools.
7. ***Scalability testing***. It is necessary to test an application that must process a large amount of data. Develop a performance testing plan, including server load and response time requirements.
8. ***Crash recovery testing***. It is necessary to test the recovery capabilities after an application failure. Create a disaster recovery scenario and verify that recovery occurs correctly and without data loss.
9. ***Mobile application testing***. Develop test scenarios to test the functionality, interface and performance of the mobile application on the platform of your choice (Android or iOS).
10. ***Testing the database management system***. It is necessary to test the database management system for speed and reliability. Develop a set of test queries and check whether the system works correctly and meets the requirements.

## IV. Evaluation policy

***Instructor's Policy Regarding the Student's Education***. Education seekers must attend practical sessions and submit corresponding assignments in a timely manner. The evaluation of work is done considering the correctly completed volume in proportion to the score defined by this syllabus, rounded up.

***Academic Integrity Policy***. Higher education seekers are allowed to study any information sources related to the task topics, as well as consult and work with their course colleagues in groups. However, tasks must be completed independently. Otherwise, the corresponding scores for the higher education seeker will not be counted.

***Policy on Sentences and Resubmissions***. Tasks must be completed within the allocated time. Late submissions will result in a 10% reduction in the corresponding evaluation score.

Assessment of the educational achievements of education seekers is carried out during ongoing monitoring of the results of performing the types of work provided by the syllabus of the educational component. (According to the Regulation on Current and Final Assessment of Knowledge of Education Seekers of Lesya Ukrainka Volyn National University).

The assessment is conducted on a 100-point scale. The grade includes ongoing assessment (evaluated based on work in class, timely and high-quality completion of homework, independent solving of individual tasks) and final modular assessment (written modular control works). The maximum number of points a student can earn during the semester's ongoing evaluation, along with the points for completing an individual task, is 40 points. The final modular assessment for the semester includes grades for all modular control works (MCWs). The maximum number of points a student can earn during modular control for the semester is 60 points.

If at least 75 points are accumulated by the end of the semester, and the higher education seeker agrees with this result, the grade for the semester may be issued without taking an exam. Otherwise, the student takes an exam; the maximum number of points that can be obtained on the exam is 60 points. They replace the scores of the modular semester control, while the ongoing semester control is retained. The exam is conducted in an oral form. The grade for the semester in case of passing the exam is the sum of the ongoing control scores, independent work, and the points obtained during the exam.

## V. Final control

The exam includes basic questions, typical and complex problems, situations, tasks that require a creative answer and the ability to synthesize the acquired knowledge and apply it when solving practical problems.

The exam is conducted orally. The following questions are presented for the exam.

The questions and form of the exam are defined in this syllabus.

**Exam questions:**

1. Basic issues of software quality
2. Basic concepts of software engineering
3. Fundamentals of software testing
4. Static testing
5. Testing planning
6. Analysis and development of test cases.
7. Organization and implementation of the testing process
8. Outsourcing testing
9. Test metrics
10. Application of testing programs based on metrics
11. Scientifically based testing methods

12. Software testing tools.
13. TMMi model
14. TMap Next model
15. TPI Next model
16. STEP model
17. CTP model
18. PDCA model
19. CMMI model
20. Software testing with agile development concepts.
21. SCRUM methodology
22. Development based on testing
23. Testing in flexible software development systems
24. Testing of security-sensitive systems
25. Reliability of the software
26. Software dependencies
27. Clean room method
28. UML and testing
29. Legal, ethical and professional aspects of software testing and maintenance.
30. Management of versions and configurations of software products.

### Examples of tasks and cases on the exam:

1. ***Test planning tasks***. Let it be necessary to test the online store. Create a typical test plan, including test types, methods, resources, and completion criteria for each test.
2. ***User interface testing case***. Let's test the registration form on the website. Create a test case, including inputs, steps, expected results, and expected error messages.
3. ***Performance testing tasks***. Suppose you need to test a web application that processes a large amount of data. Create a performance test plan, including workloads, performance metrics, and expected results.
4. ***Security testing case***. Let's test the limited access login feature. Build a test case, including hacking attempts, password validation, and security measures in place.
5. ***Conditions testing task***. Suppose it is necessary to test the functionality for calculating taxes depending on various conditions (on the example of a progressive tax). Create a set of test cases, including testing minimum and maximum values, different combinations of conditions, and expected results.

## VI. Rating scale

### A scale for evaluating the knowledge of education seekers from educational components, where the form of control is an exam

| Rating in points | Linguistic assessment | Evaluation on the ECTS scale | |
|---|---|---|---|
| | | rating | explanation |
| 90–100 | Perfect | A | excellent performance |
| 82–89 | Very good | B | above average level |
| 75–81 | Good | C | overall good job |
| 67–74 | Satisfactorily | D | not bad |
| 60–66 | Enough | E | performance meets the minimum criteria |
| 1–59 | Unsatisfactorily | Fx | Recompletion is required |

## VI. Recommended literature and Internet resources

1. Пастернак Я.М. Тестування та супровід програмного забезпечення. Електронний курс освітнього компонента. Режим доступу: https://moodle-cs.vnu.edu.ua/enrol/index.php?id=180
2. Handbook of Software Engineering. (2019). Germany: Springer International Publishing.
3. Bierig, R., Timoney, J., Galvan, E., Brown, S. (2021). Essentials of Software Testing. Singapore: Cambridge University Press.
4. Methodologies for Software Testing. (2021).: One Press Publishing.
5. O’Regan, G. (2019). Concise Guide to Software Testing. Germany: Springer International Publishing.
6. Black, R., van Veenendaal, E., Graham, D. (2021). Foundations of Software Testing ISTQB Certification, 4th Edition. United States of America: Cengage Learning.