**Программа учебной дисциплины «Software Engineering Professional Certification Preparation»**

Утверждена

Академическим советом ООП

Протокол № от «\_\_»\_\_\_\_\_20\_\_ г.

|  |  |
| --- | --- |
| Автор | Береснева Е.Н., [eberesneva@hse.ru](mailto:eberesneva@hse.ru)  Горденко М.К., [mgordenko@hse.ru](mailto:mgordenko@hse.ru) |
| Число кредитов | 8 |
| Контактная работа (час.) | 60 аудиторных часов (60 часов практических занятий) |
| Самостоятельная работа (час.) | 244 |
| Курс | 4 |
| Формат изучения дисциплины | blended learning – с использованием онлайн курса |

# Course Description

1. **Title of a Course**

The title of course – Software Engineering Professional Certification Preparation.

1. **Pre-requisites**

Successful completion of the following courses is a prerequisite for the course:

* Databases
* Programming
* Computer System Architecture
* Introduction into Software Engineering
* Discrete Mathematics
* Software Quality Assurance and Testing
* Object-Oriented Analysis and Programming
* Operating Systems
* Software Systems Design and Architecture

1. **Course Type (****compulsory, elective, optional)**

The course is elective.

1. **Abstract**

This elective three-module course is delivered at modules 1, 2 and 3 of the fourth academic year. Total course volume is 304 academic hours including 60 auditory hours (60 practice hours) and 244 self-study hours. Number of credits is 8.

The present program establishes minimum requirements to students’ knowledge and skills and determines contents and the teaching mode of the course «Software Engineering Professional Certification Preparation» (4 year), and of the assessment of students’ knowledge.

The present syllabus is designed for lecturers teaching this course, their teaching assistants and students of the degree program 09.03.04 «Software Engineering», bachelors’ program.

This syllabus meets the standards required by:

* International Educational Standard Software Engineering 2004. Curriculum Guidelines for Undergraduate Degree Programs in Software Engineering. <http://sites.computer.org/ccse/SE2004Volume.pdf>
* International Educational Standard Computer Science Curricula 2013. <http://www.acm.org/education/CS2013-final-report.pdf>
* International Educational Standard Software Engineering 2014. Curriculum Guidelines for Undergraduate Degree Programs in Software Engineering. <http://www.acm.org/binaries/content/assets/education/se2014.pdf>
* International Professional Standard IEEE – SWEBOK Guide V3. <http://www.computer.org/portal/web/swebok>
* International Competency Model IEEE – SWECOM V1.0 <http://www.computer.org/web/peb/swecom>
* Federal state educational standard of higher education in the field of preparation 09.03.04 Software Engineering (bachelor's degree) <http://fgosvo.ru/uploadfiles/ProjFGOSVO3++/Bak3++/090304_B_3plus_04042017.pdf>
* Bachelors’ program 09.03.04 «Software Engineering» of Federal Bachelors’ Degree Program <http://www.hse.ru/data/2015/05/20/1097268782/Бакалавриат_ОС_Программная%20инженерия.pdf>
* University curriculum of the bachelors’ program in 09.03.04 «Software Engineering» for 2018 <https://www.hse.ru/standards/plans/343935449/>

# Learning Objectives

The objective of course “Software Engineering Professional Certification Preparation” is to prepare students for the IEEE Computer Society Associate Software Developer Certification. It is available via link <https://www.computer.org/web/education/software-development-associate>.

The IEEE Computer Society Associate Software Developer Certification is designed to assess and validate software engineering knowledge and developing skills. Each assessment integrated a number of inter-related knowledge areas to evaluate a candidate’s ability to understand the concepts involved, integrate various knowledge areas and apply them in practice.

This certification is designed to recognize candidates who have acquired the basic knowledge and understanding required for developing software products. It requires a coherent and demonstrable understanding of the Software Engineering Code of Ethics principles and processes involved in software requirements, software design, software construction and software testing.

These knowledge areas are all identified by the Software Engineering Body of Knowledge as some of the key elements involved in software development.

# Learning Outcomes

As a result of studying the course «Software Engineering Professional Certification Preparation» the student should:

**Know:**

* various development environments and approaches to software development;
* group of methods for testing the application;
* the process of verification and validation of the program;
* the different types of the architecture of the applications;
* different design patterns;
* different testing techniques.

**Be able to:**

* verify compliance the specification with the requirements requirements;
* select the required template/design or test pattern for the actual situation;
* apply well-known patterns to real situations;
* build an application architecture in special CASE tools;
* choose the necessary method or group of methods for testing the application;
* perform verification and validation of the program;
* apply the material of the main topics of the discipline in solving test problems;
* build the architecture of the application;
* choose a testing method based on technical documentation.

**Master:**

* the skills of logical thinking in the process of solving test problems on the main topics of the discipline;
* skills of testing applications using formal methods of software engineering.

# Course Plan

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **№** | **Название раздела** | **Total** | **Auditory hours** | **Self-study** | | **Knowledge area** |
| **Seminars** |
| **The 1st module.**  **Seminars – 20 hours. Self-study – 81 hours.** | | | | | |
| **1** | Software Engineering Code of Ethics | 9 | 2 | | 7 |  |
| **2** | Software Requirements Fundamentals. | 8,5 | 1,5 | 7 | | **Software Requirements** |
| **3** | Requirements Process. | 8 | 2 | 6 | |
| **4** | Requirements Elicitation. | 8,5 | 1,5 | 7 | |
| **5** | Requirements Analysis. | 8 | 2 | 6 | |
| **6** | Requirements Specification. | 9 | 2 | 7 | |
| **7** | Requirements Validation. | 9 | 2 | 7 | |
| **8** | Practical Considerarions. | 8 | 1 | 7 | |
| **9** | Software Requirements Tools. | 7,5 | 1,5 | 6 | |
| **10** | Software Design Fundamentals. | 8 | 1 | 7 | | **Software Design** |
| **11** | Key Issues in Software Design. | 8,5 | 1,5 | 7 | |
| **12** | Software Structure and Architecture. | 9 | 2 | 7 | |
| **The 2nd module.**  **Seminars – 20 hours. Self-study – 81 hours.** | | | | | |
| **13** | User Interface Design. | 13 | 3 | 10 | |
| **14** | Software Design Quality Analysis and Evaluation. | 12 | 2 | 10 | |
| **15** | Software Design Notations. | 14 | 3 | 11 | |
| **16** | Software Design Strategies and Methods. | 13 | 3 | 10 | |
| **17** | Software Design Tools. | 13 | 3 | 10 | |
| **18** | Software Construction Fundamentals. | 12 | 2 | 10 | | **Software Construction** |
| **19** | Managing Construction. | 12 | 2 | 10 | |
| **20** | Practical Considerations. | 12 | 2 | 10 | |
| **The 3rd module.**  **Seminars – 20 hours. Self-study – 82 hours.** | | | | | |
| **21** | Construction Technologies. | 12 | 2 | 10 | |
| **22** | Software Construction Tools. | 15 | 4 | 11 | |
| **23** | Software Testing Fundamentals. | 12 | 2 | 10 | | **Software Testing** |
| **24** | Test Levels. | 12 | 2 | 10 | |
| **25** | Test Techniques. | 14 | 3 | 11 | |
| **26** | Test-Related Measures. | 12 | 2 | 10 | |
| **27** | Test Process. | 12 | 2 | 10 | |
| **28** | Software Testing Tools. | 13 | 3 | 10 | |

# Reading List

## Required

1. IEEE Computer Society. Guide to the Software Engineering Body of Knowledge (SWEBOK) V3. Accessed via <http://www.computer.org/web/swebok/v3> (2014).
2. IEEE-CS/ACM Joint Task Force on Software Engineering Ethics and Professional Practices. Accessed via <https://www.computer.org/web/education/code-of-ethics>.

## Optional

1. E. Gamma, J. Vlissides, R. Johnson, R. Helm. Design Patterns: Elements of Reusable Object-Oriented Software 1 Edition, 2015.
2. I. Sommerville. Software Engineering, 9th ed., Addison-Wesley, 2011.
3. K.E. Wiegers. Software Requirements, 2th ed., Microsoft Press, 2003.
4. S. McConnell. Code Complete: A Practical Handbook of Software Construction. 2 Redmond, WA: Microsoft Press, 2004.
5. INCOSE, Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities, version 3.2.2, International Council on Systems Engineering, 2012. Accessed via <http://www.las.inpe.br/~perondi/21.06.2010/SEHandbookv3.pdf>.
6. ISO/IEC/IEEE., 24765:2017 Systems and Software Engineering—Vocabulary, ISO/IEC/IEEE, 2017. Accessed via <https://www.smaele.nl/documents/iso/ISO-24765-2010.pdf>.
7. IEEE Std., 12207-2008 (a.k.a. ISO/IEC 12207:2008) 'Standard for Systems and Software Engineering—Software Life Cycle Processes, IEEE, 2008.
8. IEEE, IEEE Std. 1069-2009 Standard for Information Technology—Systems Design—Software Design Descriptions, IEEE, 2009.
9. ISO/IEC, ISO/IEC 42010:2011 Systems and Software Engineering—Recommended Practice for Architectural Description of Software-Intensive Systems, ISO/IEC, 2011.

# Grading System

The materials, home-tasks and other informations will be in OneNote ClassNotebook, specially created for all students of the discipline (using e-mail \*@edu.hse.ru).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type of grading** | **Type of work** | **4 year** | | | **Characteristics** |
| **1 module** | **2 module** | **3 module** |
| **Continuous** | Tests **Ti** | 2-7 weeks | 1-8 weeks | 1-10 weeks | 15-60 minutes test |
| Written home tasks **HWi** | 2-7 weeks | 1-8 weeks | 1-10 weeks | Written home tasks consist of open-answer questions |
| Massive open online course (MOOC) **M** | 1-7 weeks |  |  | After completing the MOOC, students take a final test, which is an assessment of the mastery of the course |
| **Final** | Exam **E** |  |  | 11-12 weeks | 120 minutes written exam consist of test questions and open-answer questions |

**Ti** – grades for the written tests. Tests are in a written form, they are taken in a class at the start of seminars in Microsoft Forms. Number of questions in each test is in range [10; 40]. Time limit for tests is 15-60 minutes. If some test is skipped by student, then the grade **Ti** is 0. Each correct answer gives student 1 point. For each correct answer, the student receives 1 point, so the maximum number of points per test is equivalent to the number of questions in the test.

**HWi** – grades for the written home tasks with open-answer questions. If some written home task is skipped by student or it is sent after deadline, then the grade **HWi** is 0. Score on a 10-grade scale is set proportionally to the percentage of correctly performed work.

**M** – mass open online course “Requirements Writing”. Dr Mike Ryan, Senior Lecturer from UNSW Australia (The University of New South Wales) is author. The platform is coursera.org. The course is availible via link: <https://www.coursera.org/learn/requirements-writing>.

The free registration on the site should be done using student mail (\*@edu.hse.ru). The course opens on September 03, 2018. The length of course is 5 weeks.

After completing the course, students take a final test, which is an assessment of the mastery of the course. Test consist of 25 questions. Time limit is 30 minutes. Test should be written in a class. If test is skipped by student, then the grade **M** is 0. Each correct answer gives student 1 point. For each correct answer, the student receives 1 point, so the maximum number of points is 25. Score on a 10-point scale is put in proportion to the number of correct answers. The score is rounded according to the rules of arithmetic.

Exam is a test, which consists from test and open questions on “Software Engineering Code of Ethics”, “Software requirements”, “Software design”, “Software construction” and “Software testing”. They are in a written form; test is taken in a class. Number of test questions in exam test is 40, which are available in Microsoft Forms. There are 5 open-answer questions. Time limit for exam is 120 minutes. If test is skipped by student, then the grade **E** is 0. Score on a 10-grade scale is set proportionally to the percentage of correctly performed work.

Final grade () is calculated on the basis of cumulative grade () and the final assessment (exam) grade ():

*–* the exam grade.

Cumulative grade () for the student’s work during the course consists of the successful passing of massive open online course (), tests (), home tasks () and auditorium work ():

where  is the mark obtained from final MOOC test (test should be written in class),

, where – the maximum total points for all home tasks, - the number of home tasks ;

, where – the maximum total points for all tests, - the number of tests ;

consist of attendance and activity in seminars.

# Guidelines for Knowledge Assessment

## 1. Examples of control activities

## The course is interactive. Seminars are combined with discussions of reading material, students’ self-study, mass open online course (MOOC) and mutual assessments of their work.

Example of test question from test (T):

1. Software configuration management involves identifying the configuration of the software:

[a] prior to the beginning of the lifecycle.

[b] at the beginning of the lifecycle only.

[c] at predefined points of time during the lifecycle.

[d] at the end of the lifecycle only.

Example of open-answer question from home task (HW):

Mr. C (P.Eng.), Ms. D (P.Eng.), and Mr. E are members of a design team for VEInc, an electronics company that makes computer input devices. Mr. C has an undergraduate degree in electrical engineering; Ms. D has an undergraduate degree in computer engineering; and Mr. D was trained in industrial design and is not a licensed professional engineer. Mr. C and Ms. D are in the habit of keeping track of design ideas and decisions in engineering logbooks. Mr. C tends to sketch ideas on loose sheets of paper that he sometimes tosses away at the end of a design session. The design team came up with an innovative product and the company is seeking to have the device patented. As part of the patent process all inventors must be named. Ms. D thinks that only she and Mr. C should be listed as the inventors since Mr. E has given notice that he will be leaving the company and is unlikely to have kept a record of his work. Mr. C thinks that Mr. E made a significant contribution to the device design that is to be patented. What should Mr. C do?

Example of test question from exam:

1. A software development team adopted a plan for determining the requirements for an application, which included the following:

1. Creation of an online survey requesting feedback on suggested capabilities and asking for input on desired features.

2. Construction of a document including all of the desired features identified by the survey.

3. Creation of an interface prototype.

4. Presentation of the interface to management.

Which of the following requirements engineering steps were completely omitted in the requirements engineering plan?

I. Requirements elicitation II. Requirements elaboration

III. Negotiation

IV. Requirements specification

V. Requirements validation

[a] I and II only

[b] I and V only

[c] II and IV only

[d] II and III only

Example of open-answer from exam:

Ms. B (P.Eng) works as an engineer at a subsidiary company that supplies engine components and other parts for EZee Rider Motorcycle Company. The division where Ms. B works is responsible for carrying out performance testing and quality control on all parts to ensure that they meet the requirements and allowable tolerances specified by EZee Rider. While testing a new part, Ms. B notices that none of the samples meet all of the required performance benchmarks. Ms. B brings the performance results to the attention of her supervisor who is also a licensed engineer. After reviewing the test results the supervisor tells Ms. B that this particular part is not as important to the overall performance of EZee Rider's engine as some of the other component parts that have already passed the compliance tests. Ms. B is instructed by the supervisor to omit the poor results on this particular part from her compliance report. What should Ms. B do?

Example of test question from Final MOOC test:

Identify which ONE of the following correctly identifies the error in the following requirement statement: “The System shall transition from the STANDBY mode to the other modes in less than 5 seconds.”

[a] One error: use of escape clause

[b] One error: incorrect convention for logical conditions

[c] One error: use of unbounded statements

[d] One error: incorrect use of conjunctions

[e] No error: the statement is correct

## 2. Tasks for self-assessment on the quality of mastering the course

1. Software configuration management involves identifying the configuration of the software:

[a] prior to the beginning of the lifecycle.

[b] at the beginning of the lifecycle only.

[c] at predefined points of time during the lifecycle.

[d] at the end of the lifecycle only.

2. Which of the following is not required of a software component?

[a] A unit of independent deployment

[b] Exploits commonalities in large software systems

[c] A unit of third-party composition

[d] Exposes source code for modification

3. In Modern Structured Analysis, the “event list” is used to:

[a] improve requirements traceability.

[b] build an Entity-Life History diagram.

[c] document the data transactions in the Entity-Relationship Diagram.

[d] build a preliminary Data Flow Diagram for the system.

4. An engineer is developing a web presentation layer for a mission critical project. The technology chosen for the presentation layer is making it difficult to implement the user interface design. The engineer reads about a new technology for creating the type of web interface the project needs. It is decided that a rapid prototype will be created to perform an initial evaluation of the new technology. Which of the following criteria is the LEAST important when doing the prototype?

[a] Exercising the entire breadth of functionality

[b] Simulating the operational environment

[c] Exercising critical functionality

[d] Stepping through source with a debugger

5. Cleanroom Software Engineering techniques:

[a] emphasize defect prevention rather than defect removal.

[b] minimize formal verification practices.

[c] do not require a well-defined software development process.

[d] require that each member of the development team has a unique responsibility.

6. A technical lead is working on an iterative lifecycle project that is creating a well understood application using a technology the team has experience with. The project has 10 major use cases to implement; two have just been delivered on schedule in the first iteration. At the request of the project manager, who is concerned about the amount of effort being spent fixing defects, the lead has collected some data on quality performance during the first iteration. The data shows that planned reviews of requirements and design are not occurring. It shows that 22 defects are being detected during unit and system testing per 100 SLOC.

The lead is asked to predict the defect trend for the project going forward. They calculate that with no changes in process the defect rate:

[a] will likely drop later in the project as kinks are worked out.

[b] will remain the same.

[c] will likely increase as the project progresses.

[d] cannot be predicted at this point.

7. During a software development project two similar requirements defects were detected. One was detected in the requirements phase, and the other during the implementation phase. Which of the following statements is mostly likely to be true?

[a] The most expensivedefect to correct is the one detected during the requirements phase.

[b] The most expensive defect to correct is the one detected during the implementation phase.

[c] The cost of fixing either defect will usually be similar.

[d] There is no relationship between the phase in which a defect is discovered and its repair cost.

8. An engineer is tasked to verify a software release for a mission critical system. The plan is for the release of software for verification to occur on a Monday, with verification complete the following Friday. The release turns out not to be available until Thursday. The best route for the engineer is to:

[a] verify release criteria regardless of time line.

[b] do whatever testing they can by Friday.

[c] volunteer to work the weekend.

[d] relax release criteria.

9. The IEEE-CS/ACM Software Engineering Code of Ethics and Professional Practice allows you to accept a position for which you have no pertinent training or experience if:

I. The extent of your limitations is fully disclosed.

II. Appropriate training in the pertinent area is taken concurrently.

III. The position is in a field where engineering decisions are well known.

IV. No conflict of interest is present.

[a] I only

[b] I and II only

[c] I, II, and III only

[d] I, II, III, and IV

10. Which of the following do NOT affect the accuracy of the reliability estimate during statistical testing?

I. The validity of the usage profile.

II. The number of test cases executed.

III. The programming language used to implement the code.

IV. The cyclomatic complexity of the code.

[a] I and II only.

[b] II and III only.

[c] III and IV only.

[d] I and III only.

11. Two different implementations of an abstract class (or interface) have been created. If members of the software engineering team are to be able to correctly select the appropriate implementation to use, then the documentation for each of these implementations must include:

[a] a list of functions available and data used.

[b] the source code for the implementation.

[c] information about the side effects and resource usage for each function.

[d] name of the authors of each implementation and change history.

12. A new engineer has been assigned to a project team. The current project is 1 month into construction, and another 6 months of construction are expected. The engineer discovers that the only design document is an overview of the logical architecture. There are over 70 source code files, most over 600 lines long, residing in a single folder.

It is very difficult to follow the module design of the system, but there appears to be functionality redundantly coded among the files shared between files. The best steps for improvement would be to:

I. Combine files together to reduce the number of files

II. Rework files to group functionality together

III. Use folders to group related files together

IV. Change programming languages

[a] I and II

[b] I and III

[c] II and III

[d] II and IV

13. In Structured Design, why are afferent and efferent flows identified when performing Transform Analysis?

[a] The flows represent data internal to the system.

[b] The flows are limited by the physical constraints of the devices.

[c] The system design should be independent of the format of the data.

[d] The system performance depends mainly on the time of the flows.

14. Which of the following is NOT a force that acts to encourage the generation of reference architectures?

[a] Future developers need to understand how to program future applications in a domain.

[b] A user community wants to interchange components and to inter-operate among systems.

[c] Potential customers need a principled basis for comparison among systems.

[d] The key aspects of an application domain remain invariant over time.

15. Paul has drafted a software project management plan. Which of the following items should be discussed in this plan?

I. Schedule

II. Budget

III. Requirements

IV. Staffing

[a] I, III, IV only

[b] I, II, III only

[c] I, II, IV only

[d] I, II, III, IV

16. Jo is developing a web presentation layer for a mission critical project with a challenging schedule. The project manager, who does not have a technical background, is always pressing for ways to reduce schedule risk. The project is following a staged delivery lifecycle. Requirements and architecture are completed, along with the first stage that delivered the initial database. Vertical slices of functionality are now being developed incrementally. The technology chosen for the presentation layer is making it difficult to implement the user interface design. Jo has just read about a new technology for generating the specified user interface.

Adopting a new technology at this stage of a project introduces the following risks:

I. increased integration effort and time

II. decreased usability

III. increased testing effort and time

IV. lower system performance

V. lower system reliability

[a] I and III only

[b] I, II, and III only

[c] I, III, IV, and V only

[d] I, II, III, IV, and V

17. Software metrics should be evaluated for their utility in certain areas of application. Which one of the following areas of application should NOT be considered when evaluating the utility of software metrics?

[a] Determining product complexity.

[b] Determining productivity of individual staff members.

[c] Determining when a desired state of quality has been achieved.

[d] Determining the validity of project processes.

18. Quality assurance may be applied to:

I. Requirements

II. Design

III. Code

IV. Testing

[a] I and II only

[b] I, II, and III only

[c] I, II, III, and IV

[d] IV only

19. Equivalence partitioning is:

[a] a modular programming technique where the application domain is sub-divided into similarly sized functional areas

[b] a black box testing technique that divides the input domain of a program into classes of data from which test cases can be derived

[c] an object-oriented design technique for improving program structure by replacing inheritance with delegation

[d] a software project management technique for distributing test responsibility within a project

20. A project manager is assigned to a new client who needs a web interface and database for online ordering. After assessing the scope of work, the manager decides that three GUI designers would be sufficient, and that they work at the client's site. The manager assigns the work to the first three people listed on the available staff sheet, knowing that each of them has less than two months experience at the company, but also knowing that company policy is to hire only personnel who have graduated from an accredited university with a BS degrees in a computing science.

The list below shows four ethical principles taken from the Software Engineering Code of Ethics and Professional Practice. Which principles might the manager have violated?

I. Ensure good management for any project on which they work, including effective procedures for promotion of quality and reduction of risk.

II. Assign work only after taking into account appropriate contributions of education and experience tempered with a desire to further that education and experience.

III. Not unjustly prevent someone from taking a position for which that person is suitably qualified.

IV. Ensure that software engineers are informed of standards before being held to them.

[a] I, II and III only

[b] I and II only

[c] I, II, III and IV

[d] II and III only

21. The InsurePro company develops software to support the commercial insurance industry and currently has several insurance products under development. A new customer- support application is proposed to allow customers to view the status of claims online. The development team for InsurePro responsible for developing the online claims appli- cation is working with the Customer Service department to develop the user interfaces for the claims application. The development group proposes to begin by creating Web- based forms for all claims whereas the Customer Service department proposes that po- tential users be polled to determine the most frequent use of the online system.

To develop the user interface for the online claims application, which of the following approaches would be most appropriate?

I. Polling users

II. Defining and classifying interactions

III· Developing prototype online claim forms

[a] I only

[b] I and II only

[c] III only

[d] II and III only

22. A software development team adopted a plan for determining the requirements for an application, which included the following:

1. Creation of an online survey requesting feedback on suggested capabilities and asking for input on desired features.

2. Construction of a document including all of the desired features identified by the survey.

3. Creation of an interface prototype.

4. Presentation of the interface to management.

Which of the following requirements engineering steps were completely omitted in the requirements engineering plan?

I. Requirements elicitation

II. Requirements elaboration

III. Negotiation

IV. Requirements specification

V. Requirements validation

[a] I and II only

[b] I and V only

[c] II and IV only

[d] II and III only

23. Jo is gathering the requirements for a software-controlled furnace. After interviewing several users, Jo obtained the following requirements list:

R1. Gas inlet valves should always be open when furnace is heating.

R2. Heating stops when furnace temperature reaches 150°C.

R3. Furnace temperature should increase gradually when heating.

R4. The gas inlet valves should be closed when the temperature goes above 200°C.

Which requirements defects can be identified in Jo's requirements list?

I. Ambiguous

II. Design dependent

III. Incomplete

IV. Unverifiable

[a] I only

[b] I and II only

[c] II and III only

[d] I, II and IV only

24. During a software development project two similar requirements defects were detected. One was detected in the requirements phase, and the other during the implementation phase.

Which of the following statements is mostly likely to be true?

[a] The most expensive defect to correct is the one detected during the requirements

phase.

[b] The most expensive defect to correct is the one detected during the implementation phase.

[c] The cost of fixing either defect will usually be similar.

[d] There is no relationship between the phase in which a defect is discovered and its repair cost.

25. Which of the following techniques is NOT used for validating requirements?

[a] Prototyping

[b] Animation

[c] Paraphrasing

[d] Regression

26. Which of the following statements is not a valid requirements specification?

[a] Software shall be written in C.

[b] Software shall respond to all requests within five seconds.

[c] Software shall be composed of the following twenty-three modules.

[d] Software shall use menu screens whenever it is communicating with the user.

27. User requirements describe both functional and nonfunctional aspects of the system in a way that the users of the system can understand without having detailed technical knowledge. Natural language, forms, and simple intuitive diagrams are used to docu- ment user requirements.

Natural language is typically used for user requirements specification for which of the following reasons?

[a] Ease of understanding

[b] It is unambiguous

[c] Itisprecise

[d] It eliminates misunderstanding among stakeholders

28. Jane is very pleased with the work a supplier does for her company and has referred partner companies to this supplier. Wanting to show its gratitude, the supplier has offered to update Jane s home network at a discount. This would not be a problem if:

[a] The discount is part of a publicly offered campaign.

[b] The supplier signs a written contract with Jane.

[c] The supplier has done work for others at the company.

[d] Jane s manager has the same work done in his/her house.

29. A new organization is working on its first product, an online service to enable instruc- tional videos to be viewed on-demand. The company also intends to partner with other companies so that prospective customers can also buy the needed project or lesson ma- terials needed to complete a project on one of the instructional videos (e.g., woodwork- ing or cake decorating). The product is currently in the testing phase.

The graphical user interface needs to be tested for acceptance. The inexpe- rienced testers in the group are unsure of how to proceed in order to meet this need. What is the BEST guidance that the experienced leader of the test team can provide?

[a] Run a set of black-box tests on the interface, according to tasks that the user needs to complete.

[b] Run a set of black-box tests that test the exceptional cases of product use.

[c] The unit tests test the user interface sufficiently; no other tests are possible.

[d] No testing methods exist that can test a user interface. The user needs to just use the product.

30. According to the Software Engineering Code of Ethics and Professional Practice, software engineers are expected, as appropriate, to:

I. Help develop an organizational environment favorable to acting ethically.

II. Promote public knowledge of software engineering.

III. Participate in professional organizations, meetings, and publications.

IV. Encourage colleagues to adhere to the Software Engineering Code of Ethics and Professional Practice.

V. Give full credit to the work of others.

[a] I, III, and IV only.

[b] I, III, and V only.

[c] I, III, IV, and V only.

[d] 1,11,111, IV, and V.

31. You have recently created a new software product that applies a unique method. You want to protect this unique method.

Question Referring to the above scenario, what should be pursued?

[a] Copyright.

[b] Patent.

[c] Product Registration.

[d] Trademark.

32. A systems requirements analyst is asked to review the following requirement: "The system shall be able to store one thousand (1000) 16-bit records in memory."

Which of the following requirements attributes does this requirement meet?

I. Unambiguous

II. Implementation Independent

III. Validatable

[a] I only

[b] II only

[c] I and II only

[d] I and III only

33. Which of the following requirement types should NOT be included in a Software Requirements Specification?

[a] Functional requirements

[b] Performance requirements

[c] Project requirements

[d] Maintainability requirements

34. Which of the following best describes the requirements management process?

[a] The measure of requirements quality is that they remain invariant over time

[b] A proposed requirement, once rejected, should remain rejected

[c] Change is inevitable; requirements management must accommodate change

[d] A relational database should be used when tracking requirements

35. Which of the following are least likely to be appropriate candidates for inclusion in a Software Requirements Specification?

[a] Design constraints

[b] Delivery constraints

[c] Functions to be performed

[d] Performance characteristics

36. Which of the following should be included in the Software Requirements Specification?

[a] Acceptance procedures

[b] Delivery schedules

[c] Quality attributes

[d] Quality assurance procedures

37. Which of the following diagramming techniques can be used for expressing timing requirements?

I. Data flow diagrams

II. Decision trees

III. Petri nets

IV. State charts

[a] I and III only

[b] II and IV only

[c] III and IV only

[d] II, III, and IV only

38. Which of the following types of requirements can be counted by function points?

I. Database requirements

II. User interaction requirements

III. Reporting requirements

IV. Reliability requirements

[a] I and III only

[b] I, III and IV only

[c] I, II and III only

[d] III and IV only

39. The following requirement was identified for the construction of a CASE tool:

R3: The user will be able to move the different entities of a diagram in the screen grid. Initially, the grid will be off. A zoom option will be provided by the tools. The grid might be toggled between centimeters and inches.

What course of action should be taken to best facilitate requirement man- agement and traceability?

[a] Restate the requirement to remove ambiguity in the language.

[b] Separate the requirement into a set of singular requirements.

[c] Consult the stakeholder to clarify the incomplete requirement statement.

[d] Consult the stakeholder to correct the accuracy of the requirement.

40. During the requirements validation process, two main problems were found in the re- quirements document created by analysts for a data conversion project:

• Maintainability of the specification, as requirements were specified in a way that was difficult to evolve;

• Verifiability, as some requirements were not easily demonstrable.

The requirements process took longer than planned, and as a consequence there was some delay in the project plan.

Which of the following actions is the project manager most likely to take?

[a] Fix both problems before carrying on with the project.

[b] Fix the verifiability problem and carry on with the project.

[c] Fix the maintainability problem and carry on with the project.

[d] Continue with the project and fix the problems during the design activity.

41. You are a requirements engineer on a project that will replace the current training system for a large company s training department. The orientation process will be online rather than in a traditional setting, with a trainer and a group of new employees. Although some professional development courses will be offered online for use at the employee s leisure, other courses will be offered in a traditional mode, complemented with computer-based activities. The course-registration and payment systems will be revised to improve productivity through automation. The employee s department pays for the courses that the new employee needs to complete.

Which of the following is the STRONGEST argument for using the observation elicitation technique?

[a] Direct one-on-one interaction with the user allows for an ongoing dialogue to discuss work patterns.

[b] Observation allows one to see not only the normal workflow, but also the possibility to capture atypical situations.

[c] Observation is the traditional approach for requirements gathering, and your company has experience using this technique.

[d] Observation makes it easier for observers and subjects to interact more productively as they exchange ideas in real time.

42. You are a requirements engineer on a project that will replace the current training system for a large company s training department. The orientation process will be online rather than in a traditional setting, with a trainer and a group of new employees. Although some professional development courses will be offered online for use at the employee s leisure, other courses will be offered in a traditional mode, complemented with computer-based activities. The course registration and payment systems will be revised to improve productivity through automation. The employee s department pays for the courses that the new employee needs to complete.

Your specific role on the project is as a requirements analyst.

Which of the following is NOT a primary part of your role?

[a] While working with the users, the analyst observes their work and asks them questions about what they are doing and why they are doing it.

[b] The analyst interprets the information gathered from the users in order to better understand the essence of the work.

[c] The analyst is a domain expert who is a liaison between the users and the developers.

[d] The analyst invents a new work pattern that improves the work done by the user.

43. You are a requirements engineer on a project that will replace the current training system for a large company s training department. The orientation process will be online rather than in a traditional setting, with a trainer and a group of new employees. Although some professional development courses will be offered online for use at the employee s leisure, other courses will be offered in a traditional mode, complemented with computer-based activities. The course registration and payment systems will be revised to improve productivity through automation. The employee s department pays for the courses that the new employee needs to complete.

Your organization has selected use cases as a requirements modeling tool.

Which of the following is NOT a characteristic of the application of use cases as a modeling tool?

[a] Use cases present the functionality of the system in a stepwise fashion.

[b] Use cases present the system from the user s point of view.

[c] Each use case step can represent more than one requirement.

[d] Use cases present the system from the system s point of view.

44. You are a requirements engineer on a project that will replace the current training system for a large company s training department. The orientation process will be online rather than in a traditional setting, with a trainer and a group of new employees. Although some professional development courses will be offered online for use at the employee s leisure, other courses will be offered in a traditional mode, complemented with computer-based activities. The course registration and payment systems will be revised to improve productivity through automation.

Jo, a novice requirements analyst, is overseeing the requirements engineering phase of the project. Jo has selected different models to present the system to the customer and developers. Virtually all of the effort is being dedicated to the functional requirements. The nonfunctional requirements are being neglected, and are considered to be unimpor- tant.

Which of the following is the STRONGEST argument for specifying the system’s nonfunctional requirements?

[a] Nonfunctional requirements do not take as much time to specify as functional requirements.

[b] Nonfunctional requirements are not as important as functional requirements since features are what the customer requires from the system.

[c] Nonfunctional requirements are external characteristics of the product and they can always be factored in later on.

[d] Given that the functionality is present in the system, nonfunctional attributes determine how usable and useful the product is.

45. You are a requirements engineer working on a project to develop a new racing game for a popular video game system. The game s features are based on the plot of an upcoming movie that your company has licensed the rights to use. The game s delivery date is to coincide with the release of the movie. Your organization has experience in developing educational games, but this genre is new. In order to gain market share in the gaming market, several recent college graduates have been hired as developers.

The movie studio wishes to view the game’s requirements in order to provide an official game endorsement.

Which of the following is the LEAST effective means for specifying the game s requirements?

[a] Use cases

[b] Activity diagrams

[c] A prototype

[d] Narrative format

46. The Waterfall model is being followed to develop a computer game. The requirements passed inspection, and the design inspection was approved as accurately reflecting the game's requirements. During acceptance testing, one of the expert game players in the focus group found a defect that originated in the requirements. During analysis, the requirement was determined to be of low priority. The defect did not adversely affect the game play and was not fixed.

Which of the following is the strongest argument against fixing the requirement at this stage of development?

[a] The cost of fixing the defect now is far more expensive than it would have cost to fix it earlier.

[b] Since only a small percentage of game players are likely to notice, fixing the defect it is not worth the effort.

[c] Since the game is not a critical domain application, defects found late in development are not usually fixed.

[d] Since the likelihood of causing the failure is low, the defect is not a high priority.

47. You are a requirements engineer working on a project to enhance a course-registration and payment system for a large public university system. Although you are new to the tasks needed to complete the project s requirements phase, you are asked to lead the team during the requirements elicitation phase.

You need to elicit requirements for the system. Which elicitation technique will BEST allow you to understand both the typical and atypical activities and tasks involved in course registration and payment?

[a] Observation

[b] Prototypes

[c] Interviews

[d] Questionnaires

48. The design for the XYZ project consisted of a comprehensive static view of the system captured in a drawing tool as a highly detailed set of UML class diagrams. The project moved into the construction phase, utilizing reviews to ensure the consistency of the code with the design, and automated unit tests providing 100% public interface coverage for all classes.

The initial system testing for the project went almost flawlessly. However, as more func- tionality was added, system testing uncovered more and more problems related to object lifetimes, communication between objects, and synchronization. By the time 50% of the class model was implemented, the project manager was worried that project was spiraling toward infinite defect mode.

What is the most likely design process flaw this project is facing?

[a] Use of object-oriented design

[b] Not using a CASE tool to manage the class model

[c] Insufficient design views

[d] Insufficient time spent on class design

49. The software development organization Fabulousoft is going to develop a software system for a bank. The system will be used by bank cashiers to serve customer requests. The efficiency of the cashier using the software product is critical for the success of the project. The bank has a high turnover rate for bank cashiers. A hard requirement from the bank, based on standard industry practice, is that their cashiers should be able to enter 80% of the operations into the system in less than a minute for each client.

Which of the following approaches is the best to develop a software product that meets this usability requirement?

[a] Develop the internal part of the system first, and then give it to the human factors experts so they can provide the system with a highly usable user interface.

[b] Develop a highly efficient system in terms of internal data processing, and then pro- vide the client with an intensive training program for the bank cashiers.

[c] Study the characteristics of the bank cashiers and the tasks they currently perform as a first step, and then perform iterative design on the system complemented with usability tests with real bank cashiers, until the usability goals are met.

[d] Clarify beforehand that this requirement is not feasible, and therefore Fabulousoft will decline to develop this product if the bank insists on including it as requirement.

50. When using Yourdon's structured analysis method, in which order should the main design diagrams (data flow and entity-relationship) be constructed?

[a] Entity-relationship then data flow

[b] Data flow then entity-relationship

[c] Both concurrently

[d] It does not matter

51. Structural tests derived from the implementation will NOT help the tester detect the following problems:

I. Performance problems with the code

II. Errors of omitted requirements

III. Problems arising from very large and very small numbers

IV. References through NULL pointers

[a] I and II only

[b] II and III only

[c] I, III, and IV only

[d] I, II, III, and IV

52. A company is developing an inventory-tracking application. Their testing has been pri- marily black box — functional testing. The rationale is that this is not a mission-critical application, in which safety or severe financial loss is considered to be a potential risk. The company has now learned that one of their customers is using the application to manage and track inventories of controlled substances.

Question The software development company should:

[a] Conduct a risk analysis to verify that their current test strategy is effective at uncovering potential defects that could put the customer at risk of mismanaging their inventory.

[b] Not change their test strategy since they expect that the software will continue to work well for their customers under these circumstances.

[c] Definitely include white-box testing into their current test plan. They should regression test all of their code to verify its correctness.

[d] Management should review and revise their testing policy.

53. A software product is in its third release. The current test effort is totally manual. Senior test engineers are assigned to test the new functionality of a release, whereas junior testers are assigned the task of manually conducting the regression test cases.

Question Which of the following arguments does NOT support a case for automating the regression test cases?

[a] Automated testing increases the precision with which a test is repeated.

[b] Regression testing is more likely to be executed completely with each release of the software.

[c] Automated testing can take advantage of nonworking hours.

[d] Manual testing is typically less expensive than automated testing.

54. Your company purchased a new financial accounting package from a vendor last year. The system has been in use for several months. Now that you are starting to generate your end-of-year reports, you start to notice anomalies. In order to track down the problems, you retrieve last year s input data and resulting reports to compare with the new system. When you run the new system on the old data, it produces different results than it should in a few cases. You need to identify which components of the new system are at fault, but you do not have access to the source code of the system.

Question

Which of the following testing methods should be used?

I. Branch testing

II. Boundary value analysis

III. Cyclomatic testing

IV. Equivalence partitioning

V. Mutation testing

[a] I, III, and IV

[b] II, and IV

[c] II, III, and V

[d] I, II, and IV

55. A new organization is working on its first product, an online service to enable instructional videos to be viewed on-demand. The company also intends to partner with other companies so that prospective customers can also buy the needed project or lesson materials needed to complete a project on one of the instructional videos (e.g., woodworking or cake decorating). The product is currently in the testing phase.

Management has mandated that all testing will be automated in order to achieve better quality in a shorter period of time. The testing team leader has stated in meetings that the team needs resources to improve the testing process, which she says is currently ineffective. Management responds with the argument that automation will improve testing. What is the BEST argument AGAINST automating all testing for the product?

[a] Automated regression testing finds a minority of the bugs. Reviews and inspections have the potential for detecting more defects.

[b] The testing will not improve since the automation will only result in running bad tests faster.

[c] Fewer tests will need to be run more often. The tool can run these tests faster.

[d] Automated verification of testing results has limitations that can be addressed by manual testing.

56. What type of relationship would exist between the classes Account and Customer if each Customer may own any number of Accounts (zero, one, or more) and each Account may be owned by any number of Customers?

[a] One-to-one

[b] One-to-many

[c] Many-to-many

[d] Zero-to-many

57. A new engineer has been assigned to an eight-person project team. Four developers assigned to the project have been creating designs and coding together for years. The current project is 3 months into construction, and another 6 months of construction are expected. The new engineer discovers that the design documentation is somewhat limited but acceptable, although there seem to be inconsistencies between the design document and the requirements. The code is a disappointment, being poorly documented, inconsistent, and making use of some questionable techniques. The team is willing to revisit the design documentation and expand it, but is not interested in changing coding practices.

The WEAKEST of the following arguments for increasing code quality is:

[a] The project is only a third of the way toward completion, so increasing code maintainability will increase future efficiency.

[b] The company s coding standard dictates specific code practices.

[c] Consistency across the code base will reduce the chance of defects being injected.

[d] Better written code could reduce the need to expand design documentation.

58. After the requirements phase for the XYZ project, the design team was given additional time beyond the original plan to develop a complete object-oriented class model. This model was documented with a drawing tool in a large hierarchy of highly detailed UML class diagrams. The project moved into the construction phase utilizing reviews to ensure the consistency of the code, with the design and automated unit tests providing 100% public interface coverage for all classes. Approximately 20% of the way through implementation of the classes, enough functionality was in place to allow for system testing to start on the first vertical slice of functionality. The initial system testing went almost flawlessly. The review process and unit testing were completed. As more functionality was added to the system, however, system testing uncovered an unusually large number of problems related to object lifetimes, communication between objects, and synchronization. By the time 50% of the class model was implemented, the project manager was worried that the project was spiraling toward infinite defect mode.

Question

Which of the following design techniques would have been likely to produce a reduction in the problems that the project is facing:

I. State diagrams

II. Collaboration/Sequence diagrams

III. Entity-Relation Diagrams

IV. Activity diagrams

V. Package diagrams

[a] I, II and IV only

[b] II and IV only

[c] II, IV and V only

[d] I and III only

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61. In Modern Structured Analysis, the "event list" is used to:

[a] Improve requirements traceability

[b] Build an entity-life history diagram

[c] Document the data transactions in the entity-relationship diagram

[d] Build a preliminary data flow diagram for the system

62. When using Yourdon's structured analysis method, in which order should the main design diagrams (data flow and entity-relationship) be constructed?

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[b] Data flow then entity-relationship

[c] Both concurrently

[d] It does not matter

63. In structured design, why are afferent and efferent flows identified when performing transform analysis?

[a] The flows represent data internal to the system.

[b] The flows are limited by the physical constraints of the devices.

[c] The system design should be independent of the format of the data.

[d] The system performance depends mainly on the time of the flows.

64. Which of the following statements are true about UML?

I. UML provides software developers with a language for specifying and documenting the artifacts of software systems.

II. UML represents a radical departure from the previous object-oriented development methods like Booch, OMT (Object Modeling Technique) and OOSE (Object-Oriented Software Engineering).

III. UML is designed to be independent of the software development process.

IV. An extensive knowledge of UML is enough for a software developer to succeed in an object-oriented software development project.

[a] II, and IV

[b] I and IV

[c] II and III only

[d] I and III only

65. Which of the following is NOT a factor to be considered when assessing design quality?

[a] Maintainability

[b] Reliability

[c] Stability

[d] Usability

66. In structured design, a transaction center is

[a] A module that controls the termination of tasks

[b] A process of a data flow diagram that splits the process flow into different process paths

[c] The set of data flows that appears between the afferent and efferent data flows

[d] The high-level module that controls a set of low-level modules

67. What does coupling NOT depend on?

[a] The references made from one component to another

[b] The closeness of the operations in the functions

[c] The degree of complexity in the interface between components

[d] The amount of control one component has over the other

68. Design is concerned with which of the following?

[a] Identifying and describing the operational needs of the system

[b] Performing a validation to see how well the system performs

[c] Writing system requirements in a form that can be used for implementation

[d] Describing how the system is to perform its tasks

69. Which of the following is NOT a force that acts to encourage the generation of reference architectures?

[a] Future developers need to understand how to program future applications in a domain.

[b] A user community wants to interchange components and to interoperate among systems.

[c] Potential customers need a principled basis for comparison among systems.

[d] The key aspects of an application domain remain invariant over time.

70. The data flow diagram provides a mechanism for:

I. Modeling system functions

II. Modeling databases

III. Modeling system infonnation

IV. Modeling objects

[a] I and II

[b] II and IV

[c] I and III

[d] II and IV

71. Which of the following is least likely to be a benefit of a strict layered architecture?

I. It facilitates extensibility.

II. Implementation at each level is based solely on the interfaces of the layer below.

III. It enhances system performance.

[a] I only

[b] I and II only

[c] III only

[d] II and III only

72. Which of the following statements better describe the term "entity attribute"?

I. An element (component) of a design that is structurally and functionally distinct from other elements and that is separately named and referenced.

II. A subset of design entity attribute information that is specifically suited to the needs of a software project activity.

III. A named characteristic, or property, of a design entity. It provides a statement of fact about the entity.

[a] I only

[b] II and III only

[c] III only

[d] I and II only

73. The following are all essential characteristics of an object EXCEPT:

[a] Is a unit of instantiation

[b] Has a unique identity

[c] Is a unit of independent deployment

[d] Encapsulates its state and behavior

74. Which of the following is NOT an attribute of a design pattern:

[a] Characterizes ways in which classes and objects distribute responsibility.

[b] Deals with the composition of classes or objects.

[c] Provides information regarding the pattern s appropriate use.

[d] Provides concrete classes for abstract classes.

75. A software system whose design is based on the principles of modularity and localization will result in modules that:

[a] Implement design patterns, with each design pattern only interacting locally with other design patterns

[b] Implement logically related processing elements that are relatively independent from other modules

[c] Have a minimum number of loops and conditional constructs and be relatively small in size

[d] Are designed using a top-down approach with processing implemented using a bottom-up approach.

# Methods of Instruction

Seminars, group works, written tests, written home tasks with open-answer questions and mass open online course “Requirements Writing”.

# Special Equipment and Software Support

The materials, home-tasks and other informations will be in OneNote ClassNotebook, specially created for all students of the discipline (using e-mail \*@edu.hse.ru).

Tests are created using MS Forms. Students should use a smartphone, tablet or laptop in a seminar for their passing.

Student should be enrolled to mass open online course “Requirements Writing” by Dr. Mike Ryan, Senior Lecturer from UNSW Australia (The University of New South Wales). The course is availible via link: <https://www.coursera.org/learn/requirements-writing> The free registration on the site should be done using student mail (\*@edu.hse.ru). The course opens on September 03, 2018. The length of course is 5 weeks.