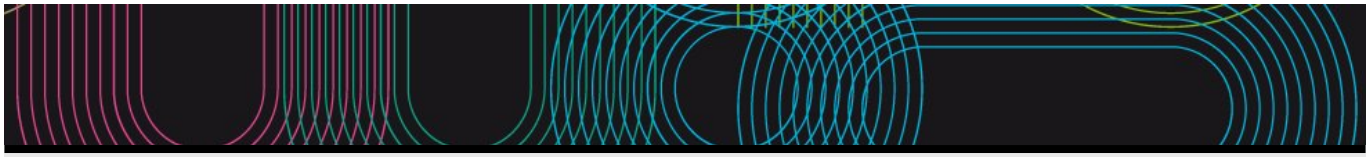

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Advanced software engineering methods** | | | | |
| Subject | Advanced software engineering methods | | | |
| Code | O06G151V01408 | | | |
| Study programme | Grado en Ingeniería Informática | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Optional | 4th | 1st |
| Teaching language | #EnglishFriendly<br>Spanish<br>Galician | | | |
| Department | | | | |
| Coordinator | Gómez Rodríguez, Alma María | | | |
| Lecturers | Gómez Rodríguez, Alma María<br>Otero Cerdeira, Lorena<br>Rodríguez Martínez, Francisco Javier | | | |
| E-mail | alma@uvigo.es | | | |
| Web | http://http://moovi.uvigo.gal | | | |
| General description | The subject introduces and makes a deeper approach in the use of mathematical based methods in the definition and development of software systems.<br>These methods will be used in definition and refinement of programs.<br>English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English | | | |

| Training and Learning Results | |
|---|---|
| Code | |
| A2 | Students will be able to apply their knowledge and skills in their professional practice or vocation and they will show they have the required expertise through the construction and discussion of arguments and the resolution of problems within the relevant area of study. |
| A4 | Students will be able to present information, ideas, problems and solutions both to specialist and non-specialist audiences. |
| B2 | Ability to manage the project□s activities from the computing field in accordance with the acquired knowledge and training. |
| B9 | Ability to solve problems by taking the initiative, making decisions and acting independently and creatively. Ability to communicate the knowledge contents, skills and abilities of the Computer Science Engineer profession. |
| B10 | Ability to carry out measurements, calculus, assessments, valuations, expert□s reports, studies, reports, task planning and other analogous computing jobs, according to the knowledge and training acquired. |
| C8 | Ability to plan, conceive, implement and manage computing projects, services and systems in every area, monitoring their implementation and their continuing improvement and assessing their economic and social impact. |
| C13 | Knowledge, design and efficient use of the most appropriate data structures and types for the resolution of a problem. |
| C26 | Ability to assess clients□ needs and determine the software requirements to satisfy these needs, reconciling conflicting goals through attempts to reach acceptable compromises within the limits imposed by costs, available times, existing developed systems and organizations themselves. |
| C29 | Ability to identify, assess and deal with associated risks that could potentially arise. |
| C32 | Ability to select, design, implement, integrate, assess, build, manage, exploit and maintain hardware, software and network technologies, within the appropriate costs and quality requirements. |
| C35 | Ability to select, design, implement, integrate and manage information systems that meet the needs of organizations, once the costs and quality criteria have been identified. |
| C36 | Ability to design systems, applications and services based on network technologies, including the Internet, web, e-commerce, multimedia, interactive services and mobile computing. |
| D4 | Analysis, synthesis and evaluation capacity |
| D6 | Ability to abstract: ability to create and use models that reflect real situations |

| | |
|---|---|
| D7 | Ability to search, relate and structure information from various sources and to integrate ideas and knowledge. |
| D10 | Interpersonal relationship skills. |
| D11 | Critical thinking |

**Expected results from this subject**

| Expected results from this subject | Training and Learning Results | | | |
|---|---|---|---|---|
| RA1: Know and comprise the main characteristics of the formal methods applied to the tasks of Software Engineering. | A4 | B10 | C8<br>C26<br>C35 | D4<br>D11 |
| RA2: Comprise the importance to use a formal approach in the development of software of quality. | A2 | B2 | C29<br>C32<br>C35 | D4<br>D7<br>D11 |
| RA3: Specify and model the requests exposed by users using a formal languages of specification. | A2 | B2<br>B9<br>B10 | C8<br>C13<br>C26<br>C29<br>C35<br>C36 | D6<br>D10 |
| RA4: Understand how the formal specification languages allow the mathematical verification of the specification and facilitate the automatic code generation. | | B10 | C29<br>C35 | D7<br>D11 |
| RA5: Use properly the tools of formal models in the activities of software specification. | A2 | B2<br>B9 | C8<br>C13<br>C35<br>C36 | |
| RA6: Comprise the concepts associated to formal verification | | B10 | C29 | D7 |
| RA7: Be able of validating a software application formally described. | A2 | B2<br>B10 | C29<br>C35<br>C36 | D6<br>D7 |

**Contents**

| Topic | |
|---|---|
| INTRODUCTION | Deficiencies of less formal approaches.<br>Concepts of formal methods.<br>Formal methods commandments. |
| SOFTWARE FORMAL MODELING. | Basic concepts.<br>Logical bases.<br>Languages for formal specification: Z, VDM...<br>The language of specification: Z.<br>Formal definitions in Z.<br>Basic Types.<br>Diagrams.<br>Sets.<br>Relations.<br>Functions.<br>Sequences.<br>Bags.<br>Operations.<br>Formal proof: Initialition theorem and Preconditions. |
| FORMAL VERIFICATION | Code and Specification<br>Application to the life-cycle. |
| DEVELOPMENT PROCESS WITH FORMAL TECHNIQUES | Changes in life cycle due to the use of formal methods<br>Applications of formal techniques.<br>Clean Room software engineering. |

**Planning**

| | Class hours | Hours outside the classroom | Total hours |
|---|---|---|---|
| Problem solving | 15 | 30 | 45 |
| Mentored work | 5.5 | 15.5 | 21 |
| Presentation | 6 | 12 | 18 |
| Lecturing | 23 | 0 | 23 |
| Objective questions exam | 1.5 | 20 | 21.5 |
| Essay questions exam | 1.5 | 20 | 21.5 |

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

| | Description |
|---|---|
| Problem solving | Application to practical exercises of the theoretical methods . |
| Mentored work | This tries to promote the autonomous learning of students, under the tutelage of the teacher in various scenarios (academic and professional). It is primarily about learning "how to do things." It is an option based on students taking responsibility for their own learning. It is based on the independent learning of students and the monitoring of that learning by the teacher-tutor. |
| Presentation | It consists of a group work technique for the study of a topic. The final result must be a document setting out the conclusions reached. Then the students will make a verbal presentation in which they present issues, works, concepts, facts or principles in a dynamic way; subjected to questions from classmates and the teacher. |
| Lecturing | It addresses the learning of the theoretical contents through the use of blackboard, audiovisual media, etc. |

## Personalized assistance

| Methodologies | Description |
|---|---|
| Mentored work | The student will be provided with followup to carry out the tasks entrusted. |

## Assessment

| | Description | Qualification | Training and Learning Results | | | |
|---|---|---|---|---|---|---|
| Problem solving | It will consist in the development of one practical project autonomously and the explanation of the work to the teacher. | 25 | A2 | B2<br>B9<br>B10 | C13<br>C26<br>C29<br>C35<br>C36 | D4<br>D7<br>D11 |
| Mentored work | It will consist in the study and development of a theoretical work in groups.<br>This method of evaluation is associated to the results of learning: RA3 and RA5. | 20 | A2 | B9 | C13<br>C29<br>C32 | D4<br>D7 |
| Presentation | It will be carried out in workgroups. This method of evaluation is associated with learning outcomes: RA1, RA2, RA4. | 25 | A2<br>A4 | B2<br>B10 | C8<br>C13<br>C26<br>C29<br>C32<br>C35<br>C36 | D4<br>D6<br>D10 |
| Objective questions exam | It will consist of several tests throughout the course, which will also allow monitoring of the student's evolution. This method of evaluation is associated with the learning outcomes: RA1, RA2, RA6, RA7. | 20 | A2 | B10 | C8<br>C32<br>C35<br>C36 | D6<br>D7 |
| Essay questions exam | The proof will consist of theoretical questions and exercises that the student has to develop to demonstrate the acquired knowledge. This method of evaluation is associated with the learning outcomes: RA1, RA2, RA3, RA5, RA6, RA7. | 10 | A2 | B9 | C13<br>C35 | D7<br>D11 |

## Other comments on the Evaluation

CONTINUOUS ASSESSMENT SYSTEM

TEST 1: Theoretical evaluation

Description: Objective test that will include evaluation of theoretical concepts.

Methodology(s) applied(s): Examination of objective questions.

% Qualification: 10%

Minimum %: For the release of this part of the course, the student must obtain a grade equal to or greater than 4 points (out of 10)).

Evaluated skills: A2,B10,C8,C32,C35,C36,D6,D7

Assessed learning outcomes: RA1, RA2, RA4

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TEST 2: Theoretical evaluation

Description: Objective test that will include evaluation of theoretical concepts and resolution of exercises.

Methodology(s) applied(s): Examination of objective questions. .

% Qualification: 10%

Minimum % (if applicable) For the release of this part of the subject the student must obtain a grade equal to or greater than 4 points (out of 10)).

Evaluated skills: A2,B10,C8,C32,C35,C36,D6,D7

Assessed learning outcomes: RA1, RA2, RA4, RA6, RA7

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TEST 3: Practical-theoretical evaluation

Description: Objective test that will include evaluation of theoretical concepts and resolution of exercises.

Methodology(s) applied(s): Examination of development questions. .

% Qualification: 10%

Minimum % (if applicable) For the release of this part of the subject the student must obtain a grade equal to or greater than 4 points (out of 10)).

Assessed skills: A2, B9,C13,C35,D7,D11

Assessed learning outcomes: RA3, RA4, RA5

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TEST 4: Exhibition works

Description: Presentation in the classroom of the theoretical work carried out in groups

Methodology(s) applied: Presentation

% Qualification: 25%

Minimum % (if applicable) For the release of this part of the subject the student must obtain a grade equal to or greater than 5 points (out of 10)).

Evaluated skills: A2,A4, B2,B10,C8, C13,C26,C29,C32,C35,C36,D4,D6,D10

Assessed learning outcomes: RA1, RA2, RA4

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TEST 5: Delivery of theoretical work

Description: Realization of the documentation analysis of the subject to prepare a theoretical summary that will later be presented in the classroom

Methodology(s) applied(s): Supervised work

% Qualification: 20%

Minimum %: For the release of this part of the subject the student must obtain a grade equal to or greater than 5 points (out of 10)).

Evaluated skills: A2,B9,C13,C29,C32,D4,D7

Assessed learning outcomes: RA3, RA5

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TEST 6: Delivery of practical work

Description: Development of a practical project autonomously and the defense before the professor of the same.

Applied Methodology(s): Troubleshooting

% Qualification: 25%

Minimum %: For the release of this part of the subject the student must obtain a grade equal to or greater than 5 points (out of 10)).

Evaluated skills: A2,B2,B9, B10, C13, C26, C29, C35, C36, D4, D7, D11

Assessed learning outcomes: RA3, RA5

IMPORTANT

 All students who take any of the tests are understood to accept the continuous assessment procedure described above.

 If a student does not take any of the tests, a grade of 0 will be assigned to it.

GLOBAL EVALUATION SYSTEM

Procedure for choosing the global assessment modality: It is considered that the student opts for the global assessment system if they do not take Test 1 of the continuous assessment system).

TEST 1: Theoretical, practical and laboratory evaluation

Description: Objective test that will include evaluation of theoretical concepts and resolution of exercises.

Methodology(s) applied(s): Problem solving, Examination of objective questions and Examination of development questions. They must appear in the top table.

% Rating: 100%

% Minimum

Assessed competencies: All of the subject

Evaluated learning outcomes: All of the subject

EVALUATION CRITERIA FOR EXTRAORDINARY CALL AND FINAL DEGREE

The global evaluation systems previously exposed will be used.

RECORD QUALIFICATION PROCESS

Regardless of the evaluation system and the call, if any part of the evaluation is not passed, but the overall score is greater than 4 (out of 10), the qualification in the minutes will be 4.

EVALUATION DATES

The dates of the tests corresponding to the continuous assessment system will be published in the calendar of activities, available on the ESEI website https://esei.uvigo.es/docencia/horarios/.

The official exam dates of the different calls, officially approved by the Xunta de Centro of the ESEI, are published on the ESEI website https://esei.uvigo.es/docencia/horarios/.

USE OF MOBILE DEVICES

All students are reminded of the prohibition of the use of mobile devices in exercises and practices, in compliance with article 13.2.d) of the University Student Statute, regarding the duties of university students, which establishes the duty to "Refrain from using or cooperation in fraudulent procedures in the evaluation tests, in the works that are carried out or in official documents of the university."

CONSULTATION/REQUEST FOR TUTORIALS

The tutorials can be consulted through the personal page of the teaching staff, accessible through https://esei.uvigo.es/docencia/profesorado/

## Sources of information

### Basic Bibliography


Pressman, Roger S., **Ingeniería del Software: Un enfoque práctico,**, 9781456287726, 7, McGraw Hill, 2010

Spivey, J.M, **Understanding Z : a specification language and its formal semantics**, 0-521-33429-2, Prentice-Hall, 1988

Woodcock, Jim, **Using Z [Recurso de Internet] : specifcation, refinement, and proof**, 2010


### Complementary Bibliography


Rosalind Barden, Susan Stepney, and David Coope, **Z in practice**, 0-13-124934-7, 1, Prentice-Hall, 1994

John J. Marciniak,, **Encyclopedia of software engineering,**, 0-471-54004-8, 1, John Wiley & Sons, 1994

Página de métodos formales, **http://fmnet.info/**,

Página del lenguaje Z, **http://www.zuser.org/**,


## Recommendations

### Subjects that it is recommended to have taken before

Software engineering 1/O06G151V01204

Software engineering 2/O06G151V01208