ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

615001060 - Embedded Systems Modelling

DEGREE PROGRAMME

61IW - Grado En Ingenieria Del Software

ACADEMIC YEAR & SEMESTER

2023/24 - Semester 2

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	615001060 - Embedded Systems Modelling
No of credits	6 ECTS
Type	Optional
Academic year ot the programme	Fourth year
Semester of tuition	Semester 8
Tuition period	February-June
Tuition languages	English
Degree programme	61IW - Grado en Ingenieria del Software
Centre	61 - Escuela Tecnica Superior De Ingenieria De Sistemas Informaticos
Academic year	2023-24

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Gustavo Adolfo Hernandez Peñaloza (Subject coordinator)	4408	gustavo.hernandez.penaloza@upm.es	Sin horario. Schedule not defined yet. Mentoring schedule will be published at the beginning of the semester according to the needs.

Jose Carlos Gamazo Real	4308	josecarlos.gamazo@upm.es	Sin horario. Schedule not defined yet. Mentoring schedule will be published at the beginning of the semester according to the needs.
Javier Garcia Martin	4419	javier.garciam@upm.es	Sin horario. Schedule not defined yet. Mentoring schedule will be published at the beginning of the semester according to the needs.

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

- Fundamentos De Ingenieria Del Software

3.2. Other recommended learning outcomes

The subject - other recommended learning outcomes, are not defined.

4. Skills and learning outcomes *

4.1. Skills to be learned

CT12 - Use of information and communication technologies : Use information and communication technologies in the field of engineering.

CT9 - Social and environmental responsibility: Knowledge, skills and attitudes to integrate in the professional activity, in a responsible and balanced way, the social, environmental and ethical aspects inherent to computer engineering.

4.2. Learning outcomes

RA455 - - Use appropriate programming tools to implement multitasking systems that follow the structure of an embedded system.

RA456 - Develops all stages of an embedded system's lifecycle

RA457 - Select the most suitable diagrams for modelling an embedded system, integrating the hardware and software parts.

RA454 - Use concurrent programming in the context of embedded systems

RA458 - Use modelling languages to specify and design an embedded system.

RA459 - Identifies the requirements and technological solutions that enable the development of embedded systems

RA460 - Use development tools for the integration of all elements required for an embedded system.

RA257 - Develops the HW and SW components of an embedded system.

RA261 - Use modelling languages to specify and design an embedded system with real-time constraints.

RA10 - Gathers and synthesises information from bibliographic sources and lectures in English

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

Embedded Systems Modelling is aimed at endowing students with the background to select the appropriate diagrams to develop a model for an embedded system according to its characteristics and needs.

The students will develop in an appropriate manner a complete lifecycle for an embedded system including the use of model language to create diagrams, with special attention to the requirements for systems that interact with hardware and sensors (embedded systems, real-time systems, etc).

The students will obtain the knowledge to apply appropriate validation techniques for the diverse diagrams' model. Furthermore, students will learn the methods to develop code enabled for the implementation of the system

5.2. Syllabus

1. Introduction to Embedded System Modelling
    1.1. Goals and principles of Modelling Languages
    1.2. Introduction to Modelling Languages
    1.3. Characteristics of embedded system programming
    1.4. Tools to develop system modelling
2. System Requirements Diagrams
    2.1. Introduction (scope, concepts and goals)
    2.2. Systems engineering
    2.3. Features and requirements specification
    2.4. Relationships between requirements and other components
    2.5. Graphical representation
3. Modelling the system Architecture

6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	**T1: Introduction to Embedded System Modelling** Duration: 02:00 Lecture	**W1: Introduction to Modelio (Or other tool for laboratory works)** Duration: 02:00 Laboratory assignments	**Group Questionnaire** Duration: 00:15 Additional activities	
2	**T2 System Requirements Diagrams (I)** Duration: 01:00 Lecture **Cased Study Presentation** Duration: 01:00 Additional activities	**Coding Basis for the case study** Duration: 02:00 Laboratory assignments		
3	**T2 System Requirements Diagrams (II)** Duration: 02:00 Lecture	**Coding Basis for the case study** Duration: 02:00 Laboratory assignments		
4	**T3: Modelling the system Architecture (I)** Duration: 02:00 Lecture	**W2: Programming a system defined by Block Diagrams** Duration: 02:00 Laboratory assignments		**Moodle Questionnaire: T1 & T2 (RA10, RA457).** Other assessment Continuous assessment Presential Duration: 00:15
5	**T3: Modelling the system Architecture (II)** Duration: 02:00 Lecture	**W2: Programming a system defined by Block Diagrams** Duration: 02:00 Laboratory assignments		
6	**T4: Modelling the system behaviour (I)** Duration: 02:00 Lecture	**W2: Programming a system defined by Block Diagrams** Duration: 02:00 Laboratory assignments		
7	**T4: Modelling the system behaviour (II)** Duration: 02:00 Lecture	**WP3: Programming a system specified by State Machine Diagrams** Duration: 02:00 Laboratory assignments		**Moodle Questionnaire: T3 & T4 (RA10, RA457, RA458).** Other assessment Continuous assessment Presential Duration: 00:15
8				**Midterm Exam 1: T1, T2, T3 & T4. (RA All)** Written test Continuous assessment Presential Duration: 01:30
9	**T5: Architecture and conceptual modelling (I)** Duration: 02:00 Lecture	**WP3: Programming a system specified by State Machine Diagrams** Duration: 02:00 Laboratory assignments		

10	**T5: Architecture and conceptual modelling (II)** Duration: 02:00 Lecture	**WP3: Programming a system specified by State Machine Diagrams** Duration: 02:00 Laboratory assignments		
11	**T6: Model-Driven Development (MDD) Engineering for embedded systems (I)** Duration: 02:00 Lecture	**W4: Modelling a complete embedded system: Selection of the appropriate diagrams and developing and validating the model** Duration: 02:00 Laboratory assignments		
12	**T6: Model-Driven Development (MDD) Engineering for embedded systems (II)** Duration: 02:00 Lecture	**W4: Modelling a complete embedded system: Selection of the appropriate diagrams and developing and validating the model** Duration: 02:00 Laboratory assignments		
13	**T7: Reliability and fault tolerance (I)** Duration: 02:00 Lecture	**W4: Modelling a complete embedded system: Selection of the appropriate diagrams and developing and validating the model** Duration: 02:00 Laboratory assignments		
14	**T7: Reliability and fault tolerance (II)** Duration: 02:00 Lecture	**W4: Modelling a complete embedded system: Selection of the appropriate diagrams and developing and validating the model** Duration: 02:00 Laboratory assignments		**Moodle Questionnaire: T5, T6 & T7 (RA10, RA459, RA458).** Other assessment Continuous assessment Presential Duration: 00:15
15			**Seminar (optional)** Duration: 01:00 Additional activities	**Case Study presentation: Final Report (RA: All)** Group presentation Continuous assessment Presential Duration: 00:20 **Exam 2: T5, T6 & T7. (RA All)** Written test Continuous assessment Presential Duration: 01:30
16				
17				**Final Exam (only for students who did not manage to pass the continous assessment (RA: All).** Written test Final examination Presential Duration: 03:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
4	Moodle Questionnaire: T1 & T2 (RA10, RA457).	Other assessment	Face-to-face	00:15	3%	0 / 10	CT12
7	Moodle Questionnaire: T3 & T4 (RA10, RA457, RA458).	Other assessment	Face-to-face	00:15	3%	0 / 10	CT12
8	Midterm Exam 1: T1, T2, T3 & T4. (RA All)	Written test	Face-to-face	01:30	25%	4 / 10	CT12
14	Moodle Questionnaire: T5, T6 & T7 (RA10, RA459, RA458).	Other assessment	Face-to-face	00:15	4%	0 / 10	CT12
15	Case Study presentation: Final Report (RA: All)	Group presentation	Face-to-face	00:20	35%	5 / 10	CT9 CT12
15	Exam 2: T5, T6 & T7. (RA All)	Written test	Face-to-face	01:30	30%	4 / 10	CT12

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Final Exam (only for students who did not manage to pass the continous assessment (RA: All).	Written test	Face-to-face	03:00	100%	5 / 10	CT9 CT12

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Final Exam: All syllabus and practical case (RA: All)	Written test	Face-to-face	02:00	100%	5 / 10	CT9 CT12

7.2. Assessment criteria

The student reaching a mark equal or larger than 5 via the continuous evaluation will be exempt of the final exam.

Students who do not pass the progressive assessment will have the opportunity to pass the course by means of the final exam, which will count for 100% of their mark. To do so, they must request this possibility to the teachers of the subject within 2 months from the beginning of the term in which the subject is taught.

EXTRARODINARY EXAM

The extra-(July) exam will consist of a Final exam that will count for 100% of the final grade. In these final exams (June and July) the student must demonstrate the same skills as those required in the progressive assessment, both in theory and in practice. It means that practical part will be composed of questions related to the case study. Students must reach a mark equal or larger than 5 in the final exam to pass.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Lenny Delligatti. 2013. SysML Distilled: A brief Guide to the Systems Modelling Language (1st ed) Addison-Wesley Professiona	Bibliography	
Designing Concurrent, Distributed, and Real-Time Applications with UML. Hassan Gomaa. Addison-Wesley	Bibliography	
Sanford Friedenthal, Alan Moore, and Rick Steiner. 2008. A Practical Guide to SysML: Systems Modeling Language. Morgan Kaufmann Publishers Inc., San Francisco, CA, USA	Bibliography	

Beydeda, S., Book, M. & Gruhn V., Model- Driven Software Development, Springer, 2005	Bibliography	

9. Other information

9.1. Other information about the subject

TRANSLATIONS

RA10 Recopila y sintetiza información de fuentes bibliográficas y de clases magistrales en inglés / Gathers and and synthesises information from bibliographic sources and lectures in English

RA458 Utiliza lenguajes de modelado para especificar y diseñar un sistema empotrado // Uses modelling languages to specify and design an embedded system

RA454 Utiliza la programación concurrente en el contexto de los sistemas empotrados. // Uses concurrent programming in the context of embedded systems.

RA456 Desarrolla todas las etapas del ciclo de la vida de u sistema empotrado // Develops all lifecycle stages of an embedded system.

TRANSVERSAL COMPETENCES

This subject, aims at covering the aforementioned competences by combining the theoretical knowledge with it's application in practice settings. The students are actively working in the case study where they have the opportunity to apply the techniques for close-to-market problems. In order to cope with these competences, the "

Resultados de aprendizaje /Learning Results (RA)" were defined: The interrelation between the concurrent programming applied to embedded systems and real-time systems for optimal performance. For the competences training, the following activities are foreseen:

1) Release of the subject contents including, slides presentation, bibliography and references with the ambition of making the links between engineering, environment and social responsibilities.

2) A talk about the social impact and environmental of the case study implemented in the subject will allow them to create consciousnesses of the impact while aligning with the United Nations Sustainable Development Goals SDG.

The results will be evaluated in the "Project presentation", where studies will have to incorporate in the report an analysis and an essay about the impact that the developed system will have for some of the society fields including economy, social wellbeing, human rights, environment). This part counts for a 20% of the project mark