ECTS Information Package: Degree Programme

Master´s degree in

# COMPUTER ENGINEERING - INTERNET OF THINGS

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# A - General Description

**Programme Title** - Mestrado em Engenharia Informática-Internet das Coisas

**Qualification awarded** - Master´s degree in Computer Engineering - Internet of Things

**Level of qualification** - Second-cycle degree, EQF Level 7; ISCED Level 5

**Specific admission requirements**

General

According to the Portuguese Law, the following candidates are eligible for entry to the course of study leading to the *Mestre* degree:

- Holders of a *licenciado* degree or legally equivalent corresponding to the first cycle of higher education;
- Holders of a foreign higher degree awarded on completion of a first-cycle programme organised in the framework of the Bologna Process;
- Holders of a foreign higher degree which is deemed by the Technical-Scientific Committee of ESTT-IPT to meet the requirements of a *licenciado* degree.
- Holders of an academic, scientific or professional curriculum which is deemed by the Technical/Scientific Committee of ESTT-IPT as appropriate to access the programme.

Specific

Holders of a pre-Bologna degree (3-year Bacharelato or 5-year Licenciatura) or a Bologna Licenciatura in Computer Engineering or related areas (Electrical Engineering, Physical Engineering, Mechanical Engineering, and others).

Holders of an academic, scientific or professional curriculum which is deemed by ESTT?s Scientific Committee to meet the necessary requirements to access this study program.

**Specific arrangements for recognition of prior learning (formal, non-formal and informal)**

General
Granting of credits from prior learning is regulated by the Portuguese Law taking into account the level of credits and the field of study where they have been earned and is subject to the recognition of ESTT-IPT Technical/Scientific Committee.

- Training undertaken in the context of other higher education programmes of study from national or foreign HE establishments or organised in the framework of the Bologna Process or other prior learning can be credited towards the present programme of study;
- Credits earned from postgraduate studies can also be credited towards this programme of study;
- Professional experience or other training, different from the abovementioned ones, can also be credited towards this programme of study.

Specific
Allocation of credits to individuals holding a degree in Computer Engineering or similar programs prior to Bologna with a duration equivalent to 300 ECTS credits (5 years of study) is formally analysed on a case-to-case basis.

**Qualification requirements and regulations:**

Masters courses are regulated by the Portuguese legislation and by the regulatory standards of the master's courses defined by the School of Technology of Tomar.

To complete the master's studies cycle it is necessary to obtain 120 ECTS Credits, distributed over 4 curricular semesters according to the curricular structure of the course. Each ECTS credit corresponds to 27 hours of total student work.

**Profile of the program:**

The Master´s degree in Computer Engineering - Internet of Things (MCE-IoT) has as main objective to provide professional and specialized training in the areas of intelligent systems, wireless sensor networks, software engineering and in the modern technologies and methodologies associated with science and programming technology .

The Master´s degree in Computer Engineering presents a new training approach focused on the new IoT paradigm, which will allow master studentsto obtain solid and practical training in the areas that support the development of IoT services and applications, in a training profile that allows the participation in projects integrating these technologies in companies.

Development and deployment of these technologies is supported in partnerships with several national companies of reference in these areas.

**Key learning outcomes:**

Graduates from this program are expected to be able to apply relevant concepts and techniques of:

- development of IoT applications and services; - development of machine learning algorithms; - processing and computing large volumes of data; - analysis and development of solutions for sensor networks; - specification of requirements and software development;- development of advanced mobile applications.

**Occupational profiles of graduates with examples:**

Holders of the master's degree in Computer Engineering will be prepared to integrate public entities, national and international reference companies that need specialized technicians in the areas of software engineering, intelligent systems and programming sciences with the following professional profile (among others):

- development of IoT applications and services; - development of machine learning algorithms; - processing and computing large volumes of data; - analysis and development of solutions for sensor networks; - specification of requirements and software development;- development of advanced mobile applications.

**Access to further studies:**

The master's degree in Computer Engineering gives access to third-cycle programs in areas of Computer Engineering and other related areas according to applicable admission regulations.

## Course structure diagram with credits

| Course code | Course Title | Year | Semester | Credits |
|---|---|---|---|---|
| 390913 | Big Data Processing | 1 | S1 | 10 |
| 390914 | Machine Learning | 1 | S1 | 10 |
| 39092 | Software Engineering | 1 | S1 | 10 |
| 390915 | Advanced Mobile Applications Development | 1 | S2 | 10 |
| 39095 | Cloud Computing and Virtualization | 1 | S2 | 10 |
| 390916 | Information Technology Infrastructures and Security | 1 | S2 | 10 |
| 390910 | | 2 | A | 56 |
| 39099 | Seminar | 2 | S1 | 4 |

(*) This course may not be available in certain academic years. Please confirm availability with the Erasmus coordinator.

**Examination regulations, assessment and grading**

General
Assessment of course units complies with the Academic Regulations in force at ESTT-IPT, except for the Dissertation, Project and Internship, to which apply the provisions set out in the regulations for the master's degrees offered by the ESTT-IPT.

- Dissertation, Project and Internship have only two assessment seasons and the students are free to choose only one.
- The assessment calendar for the Dissertation, Project and Internship is proposed by the Programme Coordinating Committee to the Technical/Scientific Committee at the beginning of each academic year.
- The general grade improvement scheme does not apply to the Dissertation, Project and Internship.

The overall grade of the master's programme is the arithmetic weighted average rounded off to the ones of the number of ECTS credits and the grades of the course units that form part of the programme of study.
The 10-20 mark expressed on a 0-20 scale is converted into its equivalent in the European grading scale with the awards Satisfactory, Good, Very Good or Excellent.

Specific

**Graduation requirements:**

The completion of the study cycle requires the approval of all the curricular units comprising it, including the public defense of the project work or the internship report, in order to obtain 120 ECTS credits according to the general and specific evaluation rules

**Mode of study:**
Full- or part-time. Evening program.

**Program director or equivalente**

Director: Ana Cristina Barata Pires Lopes
Erasmus coordinator: Gabriel Pereira Pires

# B - Description of individual course units

| | |
|---|---|
| **Course unit title** | Big Data Processing |
| **Course unit code** | 390913 |
| **Type of course unit** | Compulsory |
| **Level of Course unit** | Second Cycle |
| **Year of Study** | First Year |
| **Semester/Trimester when the course unit is delivered** | First Semester |
| **Number of ECTS credits allocated** | 10 |
| **Name of Lecturer(s)** | Ricardo Nuno Taborda Campos |
| **Learning outcomes of the course unit** | 1. Understand the importance of Python in Data Science 2. Be aware of ethical issues in the process of collectinf and use of information 3. Master the data collection process 4. Knowing how to apply information extraction methods 5. Be familiar with the 5V's 6. Knowing how to use the main frame |
| **Mode of delivery** | Face-to-face |
| **Prerequisites and co-requisites** | NA |
| **Recommended optional programme componentes** | NA |
| **Course contentes** | 1. Python in the context of Big Data 2. Data Ethics and Privacy 3. Data Acquisition 4. Information Extraction 5. Introduction to Big Data (Map-Reduce Programming Model) 6. Big Data Frameworks |
| **Recommended or required Reading** | - Santos, M. e Costa, C. (2019). *Big Data - Concepts, Warehousing, and Analytics*. (pp. 1-312). Lisboa: FCA<br>- Foster, I. e Ghani, R. e Jarmin, R. e Kreuter, F. e Lane, J. (2017). *Big Data and Social Science. A Practical Guide for Methods and Tools*. (pp. 1-349). New York: Taylor & Francis<br>- Erl, T. e Khattak, W. e Buhler, P. (2016). *Big Data Fundamentals: Concepts, Drivers & Techniques*. USA: Prentice Hall<br>- Sarkar, D.(2021). *Text Analytics with Python: A Practitioner's Guide to Natural Language Processing*. (pp. 1-661). USA: Apress |
| **Planned learning activities and teaching methods** | Exposure of the syllabus using the expository and demonstrative method. Analysis and resolution of practical cases through Python notebooks. The acquired knowledge will be evaluated through the realization and presentation of projects |
| **Assessment Methods and criteria** | Periodic evaluation: Project (60%) + Exam (40%) The delivery of the project is mandatory for obtaining approval in the course during the periodic evaluation which assumes a minimum of 70% attendance. The delivery after the foreseen period implies the reproval of the student, making it impossible for him/her to propose to the exam. Students are also automatically excluded from the exam if they obtain a score of less than 6 values in the project or if they do not reach a minimum number of attendances. Final Assessment: Exam (100%) |
| **Language of Instruction** | Portuguese |
| **Work placement(s)** | NA |

# B - Description of individual course units

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|---|---|
| **Course unit title** | Machine Learning |
| **Course unit code** | 390914 |
| **Type of course unit** | Compulsory |
| **Level of Course unit** | Second Cycle |
| **Year of Study** | First Year |
| **Semester/Trimester when the course unit is delivered** | First Semester |
| **Number of ECTS credits allocated** | 10 |
| **Name of Lecturer(s)** | Gabriel Pereira Pires<br>Renato Eduardo Silva Panda |
| **Learning outcomes of the course unit** | The main objective of this course is to provide students with knowledge about machine learning with a focus on supervised classification. By the end of this course, it is expected that students will be able to implement all steps of the classification pipeline and apply them to real world problems. |
| **Mode of delivery** | Face-to-face |
| **Prerequisites and co-requisites** | Algebra and statistics. |
| **Recommended optional programme componentes** | NA |
| **Course contentes** | 1. Introduction to machine learning; 2. Simple and multiple linear regression; 3. Normalization and scaling; 4. Classifiers: Bayes, LDA, Logistic regression, KNN, SVM, Neural Networks; 5. Validation methods and classifier evaluation metrics; 6. Application of the methods discussed in different areas (economics, engineering, medicine, etc); |
| **Recommended or required Reading** | - Guido, S. e Muller, A. (2016). *Introduction to Machine Learning with Python: A Guide for Data Scientists*. USA: O'Reilly<br>- Bishop, C.(2006). *Pattern recognition and machine learning*. USA: Springer |
| **Planned learning activities and teaching methods** | Expository classes; Programming-oriented problem solving classes; Realization of projects. |
| **Assessment Methods and criteria** | Assignments (homework): 20% Individual or group projects: 60% Assessment test: 20% Homework and projects have deadlines that are defined throughout the semester. These evaluation method criteria apply to all evaluation seasons. |
| **Language of Instruction** | Portuguese \| **Mentoring in** English |
| **Work placement(s)** | NA |

# B - Description of individual course units

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|---|---|
| **Course unit title** | Software Engineering |
| **Course unit code** | 39092 |
| **Type of course unit** | Compulsory |
| **Level of Course unit** | Second Cycle |
| **Year of Study** | First Year |
| **Semester/Trimester when the course unit is delivered** | First Semester |
| **Number of ECTS credits allocated** | 10 |
| **Name of Lecturer(s)** | José Casimiro Nunes Pereira<br>Renato Eduardo Silva Panda |
| **Learning outcomes of the course unit** | Learn to apply software development methodologies, namely agile methodologies when developing modern web applications using a continuous integration approach. Exposure to state-of-the-art technologies and paradigms used to develop complex software solutions. |
| **Mode of delivery** | Face-to-face |
| **Prerequisites and co-requisites** | NA |
| **Recommended optional programme componentes** | NA |
| **Course contentes** | Traditional vs. Agile software development methodologies. Application of agile concepts to develop modern software. Software development topics: Model-View-Controller (MVC) paradigm, web frameworks, RESTful APIs and SPAs, ORM systems, VCS, code reviews and continuous integration, automated tests, WebSockets, caching, background jobs and message queues. |
| **Recommended or required Reading** | - Ruby, S.(2022). *Agile Web Development with Rails 7*. US: Pragmatic Bookshelf<br>- Sutherland, J. e Schwaber, K. (0). *The definitive guide to scrum: the rules of the game*.Acedido em21 de novembro de 2018 em https://www.scrum.org/resources/scrum-guide |
| **Planned learning activities and teaching methods** | Theoretical presentations to introduce concepts and practical workshops to demonstrate and experiment with new technologies. Practical labs are used to discuss, plan, and develop the practical project (most work is extra-class). |
| **Assessment Methods and criteria** | Theoretical (25%, 5 points in 20) – Written exam (closed-book), with a minimum grade of 35% to be approved. Practical (75%, 15 in 20) – Practical group project (software development using technologies introduced weekly), evaluated continuously (per sprint, as well as final deliverables). |
| **Language of Instruction** | Portuguese \| **Mentoring in** English |
| **Work placement(s)** | NA |

# B - Description of individual course units

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|---|---|
| **Course unit title** | Advanced Mobile Applications Development |
| **Course unit code** | 390915 |
| **Type of course unit** | Compulsory |
| **Level of Course unit** | Second Cycle |
| **Year of Study** | First Year |
| **Semester/Trimester when the course unit is delivered** | Second Semester |
| **Number of ECTS credits allocated** | 10 |
| **Name of Lecturer(s)** | José Casimiro Nunes Pereira |
| **Learning outcomes of the course unit** | 1 - Identify the requirements of mobile application development 2 - Implement mobile applications according to the most appropriate technologies and providing the best user experience 3 - Define and implement the best mobile application testing approaches |
| **Mode of delivery** | Face-to-face |
| **Prerequisites and co-requisites** | NA |
| **Recommended optional programme componentes** | NA |
| **Course contentes** | 1 - Mobile Apps development specificities 2 - Mobile Development Lifecycle Overview - Form Factors and User Input - Architecture, Design and Engineering Considerations - Usability and User Interaction Design 3 - Developing the Mobile App - Persistent Data - Maps and Location - Access to Hardware and Sensors 4 - Testing and Publishing Apps - App Distribution Through App Stores |
| **Recommended or required Reading** | |
| **Planned learning activities and teaching methods** | Lectures and tutorials. |
| **Assessment Methods and criteria** | Development of a mobile application: - native development (Kotlin): 100% final grade - need access to hardware sensors - need access to API (to backend data) - version control (GitHub) |
| **Language of Instruction** | Portuguese |
| **Work placement(s)** | NA |

# B - Description of individual course units

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|---|---|
| **Course unit title** | Cloud Computing and Virtualization |
| **Course unit code** | 39095 |
| **Type of course unit** | Compulsory |
| **Level of Course unit** | Second Cycle |
| **Year of Study** | First Year |
| **Semester/Trimester when the course unit is delivered** | Second Semester |
| **Number of ECTS credits allocated** | 10 |
| **Name of Lecturer(s)** | Luís Miguel Lopes de Oliveira<br>Renato Eduardo Silva Panda |
| **Learning outcomes of the course unit** | Concepts of virtualization and cloud computing. Understanding the fundamentals of virtualization. Knowing the infrastructure to support a cloud platform. Know how to develop scalable solutions using cloud solutions. Architect a cloud solution according to the service requirements. |
| **Mode of delivery** | Face-to-face |
| **Prerequisites and co-requisites** | NA |
| **Recommended optional programme componentes** | NA |
| **Course contentes** | 1 - Basic information technology and data center operations 2 - Cloud computing overview 3 - Programming overview: programming languages and web platforms for cloud computing 4 - Virtualization technology 5 - Cloud architecture: 5.1 - IaaS 5.2 - PaaS 5.3 - SaaS 6 - Cloud Elasticity |
| **Recommended or required Reading** | - J. Kavis, M.(2014). *Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)*. (Vol. --). --: Wiley |
| **Planned learning activities and teaching methods** | Theoretical-practical classes, supported by audio-visual to introduce concepts, followed by practical examples. Practical-laboratory classes to experiment with the introduced concepts on practical cases. |
| **Assessment Methods and criteria** | Evaluation will focus on the development and presentation of a practical project during the semester. The deliverables include a report and presentation with discussion. The developed solution has a weight of 60%, the report has a weight of 30% and the presentation has a weight of 10%. |
| **Language of Instruction** | Portuguese |
| **Work placement(s)** | NA |

# B - Description of individual course units

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|---|---|
| **Course unit title** | Information Technology Infrastructures and Security |
| **Course unit code** | 390916 |
| **Type of course unit** | Compulsory |
| **Level of Course unit** | Second Cycle |
| **Year of Study** | First Year |
| **Semester/Trimester when the course unit is delivered** | Second Semester |
| **Number of ECTS credits allocated** | 10 |
| **Name of Lecturer(s)** | Luís Miguel Lopes de Oliveira |
| **Learning outcomes of the course unit** | 1- Identify the most components in the IoT ecosystem. 2- Design and implement the infrastructure to support IoT services. 3- Design and implement security strategies to minimize the security risks 4- Identification and mitigation of privacy threats. |
| **Mode of delivery** | Face-to-face |
| **Prerequisites and co-requisites** | NA |
| **Recommended optional programme componentes** | NA |
| **Course contentes** | 1- Data networks infraestruture 1.1. The TCP/IP protocols most used on IoT networks 1.2. Data storage em processing solutions for IoT networks 2- Cybersecurity 2.1. Identification of the most relevant threats 2.2.Security attacks detection and mitigation 2.3 Privacy |
| **Recommended or required Reading** | - AAbraham, A., & Mcheick, H. , J.(2019). *Ubiquitous Computing and Computing Security of IoT*. Amsterdam: Springer International Publishing. |
| **Planned learning activities and teaching methods** | Theoretical sessions to present and discuss the main concepts and laboratory sessions to solve real problems related with network infrastructures and security. |
| **Assessment Methods and criteria** | The assessment comprises two components: i) laboratory practice and ii) project. The practical component has a weight of 40% and consists in the assessment of practical work carried out throughout the semester, individually or in teams of students. The project component has a weight of 60%, and comprises the assessment of the project report and the oral presentation. The two components have a minimum score of 10 points. All assessment components are mandatory. |
| **Language of Instruction** | Portuguese |
| **Work placement(s)** | NA |

# B - Description of individual course units

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|---|---|
| **Course unit title** | Seminar |
| **Course unit code** | 39099 |
| **Type of course unit** | Compulsory |
| **Level of Course unit** | Second Cycle |
| **Year of Study** | Second Year |
| **Semester/Trimester when the course unit is delivered** | First Semester |
| **Number of ECTS credits allocated** | 4 |
| **Name of Lecturer(s)** | |
| **Learning outcomes of the course unit** | NA |
| **Mode of delivery** | Face-to-face |
| **Prerequisites and co-requisites** | NA |
| **Recommended optional programme componentes** | NA |
| **Course contentes** | NA |
| **Recommended or required Reading** | - Atzori, L. e Morabito, G. (2010). The Internet of Things: A survey. .*Comput. Netw*, *54*, pp. 2787-2805. |
| **Planned learning activities and teaching methods** | NA |
| **Assessment Methods and criteria** | NA |
| **Language of Instruction** | Portuguese |
| **Work placement(s)** | NA |