



## Study Plan

**School:** School of Sciences and Technology  
**Degree:** Master  
**Course:** Informatics Engineering (E-Learning) (cód. 578)

### 1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF7192M	Applied Artificial Intelligence	Informatics	6	Semester	157
INF7193M	Computer-Based Decision Support Systems	Informatics	6	Semester	157
INF7194M	Advanced Topics in Compilation	Informatics	6	Semester	157
INF7195M	Advanced Topics in Distributed Systems	Informatics	6	Semester	157



### 1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
<b>Group of Options</b>					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF7033M	Text Based Information Retrieval	Informatics	6	Semester	157
INF7191M	Multimodal Systems	Informatics	6	Semester	157
GES7014M	Information Systems Management	Management	6	Semester	161
MAT7177M	Cryptography	Informatics	6	Semester	157
INF7173M	advanced Topics in Digital Processing	Informatics	6	Semester	157
INF7176M	Location Based Services	Informatics	6	Semester	157
INF7190M	Embedded Systems	Informatics	6	Semester	157
INF7171M	Declarative Languages Implementation	Informatics	6	Semester	157
INF7179M	Distributed Information Systems / System Interoperability and Integration	Informatics	6	Semester	157
INF7017M	Data Warehouse	Informatics	6	Semester	157
INF7187M	Natural Language Processing Systems	Informatics	6	Semester	157
INF7170M	Machine Learning	Informatics	6	Semester	157
INF7174M	Ubiquitous Computing	Informatics	6	Semester	157
INF7175M	Game Design	Informatics	6	Semester	157
INF7178M	Declarative Information Systems	Informatics	6	Semester	157
INF7185M	Data Mining	Informatics	6	Semester	157
INF7186M	Computer-Based Decision and Control Systems	Informatics	6	Semester	157
INF7172M	Reasoning and Knowledge Representation	Informatics	6	Semester	157
INF7181M	Multimedia Information System	Informatics	6	Semester	157
INF7180M	Software Engineering	Informatics	6	Semester	157
INF7188M	Digital Signals Processing	Informatics	6	Semester	157

### 1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF7183M	Human-Machine interfaces	Informatics	6	Semester	157
GES7182M	Project Management	Management	6	Semester	157
INF7184M	Advanced topics in Databases	Informatics	6	Semester	157



1st Year - 2nd Semester

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<b>Group of Options</b>					
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INF7033M	Text Based Information Retrieval	Informatics	6	Semester	157
INF7176M	Location Based Services	Informatics	6	Semester	157
INF7190M	Embedded Systems	Informatics	6	Semester	157
INF7171M	Declarative Languages Implementation	Informatics	6	Semester	157
INF7179M	Distributed Information Systems / System Interoperability and Integration	Informatics	6	Semester	157
INF7017M	Data Warehouse	Informatics	6	Semester	157
INF7187M	Natural Language Processing Systems	Informatics	6	Semester	157
INF7170M	Machine Learning	Informatics	6	Semester	157
INF7174M	Ubiquitous Computing	Informatics	6	Semester	157
INF7175M	Game Design	Informatics	6	Semester	157
INF7178M	Declarative Information Systems	Informatics	6	Semester	157
INF7185M	Data Mining	Informatics	6	Semester	157
INF7186M	Computer-Based Decision and Control Systems	Informatics	6	Semester	157
MAT7177M	Cryptography	Informatics	6	Semester	157
INF7173M	advanced Topics in Digital Processing	Informatics	6	Semester	157
GES7014M	Information Systems Management	Management	6	Semester	161
INF7191M	Multimodal Systems	Informatics	6	Semester	157
INF7172M	Reasoning and Knowledge Representation	Informatics	6	Semester	157
INF7181M	Multimedia Information System	Informatics	6	Semester	157
INF7180M	Software Engineering	Informatics	6	Semester	157
INF7188M	Digital Signals Processing	Informatics	6	Semester	157



2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
<b>Group of Options</b>					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF7033M	Text Based Information Retrieval	Informatics	6	Semester	157
INF7172M	Reasoning and Knowledge Representation	Informatics	6	Semester	157
MAT7177M	Cryptography	Informatics	6	Semester	157
INF7191M	Multimodal Systems	Informatics	6	Semester	157
INF7173M	advanced Topics in Digital Processing	Informatics	6	Semester	157
INF7176M	Location Based Services	Informatics	6	Semester	157
INF7190M	Embedded Systems	Informatics	6	Semester	157
INF7171M	Declarative Languages Implementation	Informatics	6	Semester	157
INF7179M	Distributed Information Systems / System Interoperability and Integration	Informatics	6	Semester	157
INF7017M	Data Warehouse	Informatics	6	Semester	157
INF7187M	Natural Language Processing Systems	Informatics	6	Semester	157
GES7014M	Information Systems Management	Management	6	Semester	161
INF7170M	Machine Learning	Informatics	6	Semester	157
INF7174M	Ubiquitous Computing	Informatics	6	Semester	157
INF7175M	Game Design	Informatics	6	Semester	157
INF7178M	Declarative Information Systems	Informatics	6	Semester	157
INF7185M	Data Mining	Informatics	6	Semester	157
INF7186M	Computer-Based Decision and Control Systems	Informatics	6	Semester	157
INF7181M	Multimedia Information System	Informatics	6	Semester	157
INF7180M	Software Engineering	Informatics	6	Semester	157
INF7188M	Digital Signals Processing	Informatics	6	Semester	157
INF7189M	Seminars	Informatics	6	Semester	157
<b>Mandatory alternatives</b>					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
	Dissertation				
	Internship				



## 2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
<b>Mandatory alternatives</b>					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
	Dissertation				
	Internship				

### Conditions for obtaining the Degree:

\*\*\* TRANSLATE ME: Para aprovação na componente curricular é necessário a aprovação (através de avaliação ou creditação) das seguintes unidades Curriculares: { \ } newline

1º Semestre: { \ } newline

4 UC obrigatórias num total de 24 Ects { \ } newline

1 UC Optativa num total de 6 Ects { \ } newline

2º Semestre: { \ } newline

3 UC Obrigatórias num total de 18 Ects { \ } newline

2 UC Optativas num total de 12 Ects { \ } newline

3º Semestre: { \ } newline

1 UC obrigatória num total de 6 Ects { \ } newline

1 UC optativa num total de 6 Ects { \ } newline

Para obtenção do grau é necessário também a aprovação em Dissertação, Relatório de Estágio ou Trabalho de Projecto, no total de 48 ECTS, no 3.º e 4.º Semestre. \*\*\*

## Program Contents

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### Applied Artificial Intelligence (INF7192M)

Uncertain knowledge and reasoning

(1) Introduction to Uncertainty

(2) Theory of probability: Syntax and semantics of probability theory, Bayes' rule and Independence;

(3) Introduction to Bayesian Networks: Syntax, Semantics; distributions parameterized

(4) Inference in Bayesian networks; Exact Inference by enumeration, elimination of variables; Approximate Inference by Stochastic Simulation; by Markov Chain Monte Carlo

(5) Temporal Probability Models: Time and uncertainty Inference, hidden Markov models, Kalman filters, dynamic Bayesian networks, particle filtering

(6) Applications of Bayesian Networks and Models of Probability: Speech Recognition, Task natural language processing.

(7) Rational decisions: preferences, utility networks, decision and value of information

(8) Learning from observation, learning by induction, decision trees; Measuring the performance of learning, statistical learning.; Bayesian Learning: learning maximum likelihood parameters with complete data.



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### **Computer-Based Decision Support Systems (INF7193M)**

Decision process

Decision environments

Computer-Based Information Systems (CBIS)

Decision models

Decision support systems (DSS)

General Definition

Characteristics, capabilities and classification

Components: data, models, knowledge, interface

Expert systems

Development strategies of a DSS

Phases of the development process of a DSS

Development tools

Prototyping

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### **Advanced Topics in Compilation (INF7194M)**

1. Building the back-end of a compiler

1.1. Intermedium code

1.2. Registers selection

1.2.1. Graph-coloring algorithms

1.2.2. Sethi-Ulman algorithm

1.3. MIPS code generation

2. Compiling object oriented languages

3. Compiling functional language

4. Optimizations

4.1. Flow analysis

4.2. Cycles

4.3. SSA-Form (single-form assignment)

4.4. Pipelining and scheduling

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### **Advanced Topics in Distributed Systems (INF7195M)**

1. Parallel memory architectures (UMA and NUMA)

2. Shared memory

3. Distributed shared memory

4. Programming concurrent systems with POSIX Threads

5. Distributed programming with MPI

6. Virtual machines

7. Grids and cloud computing (SaaS/PaaS/IaaS)

8. Performance analysis methodology



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### **Text Based Information Retrieval (INF7033M)**

1. Introduction; main concepts and problems
2. Boolean, vectorial, and probabilistic models
3. Indexing, lemmatization, stop-words
4. Ontologies
5. Query Languages
6. Evaluation
7. Searching the web
8. Semantic web
9. Text classification
10. Text clustering
11. Information extraction
12. Question-Answering systems

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### **Multimodal Systems (INF7191M)**

Concept of Multimodal Systems  
Interaction Modalities  
Natural Language: Speech and Text as Person to Machine interface  
VoiceXML, Ink Markup Language  
Tangible interfaces  
Computer Vision, Recognition of Gestures and Movement  
Multimodal Systems Architecture  
Integration of different interaction modalities  
Prospects for future development

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### **Information Systems Management (GES7014M)**

- 0 - Problematic, Main Goals and content of the course;
- 1 - Organization, Management, system and Information, Information and Communication Technologies;
- 2 - Strategy and Information Systems and Technologies (IS/IT);
- 3 – Information Systems Management;
- 4 – Investments Management on IS/IT; Knowledge Management

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### **Cryptography (MAT7177M)**

Integers  
Congruences and Residue Class Rings  
Encryption  
Probability  
DES  
Public-Key  
Discret Logarithms  
Hash Functions  
Digital Signatures  
Finite Fields  
Elliptic Curves



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### **advanced Topics in Digital Processing (INF7173M)**

Discrete-time and continuous-time systems. Block diagram algebra. Feedback and stability of dynamical systems. Feedback control and regulation systems.

Systems described by continuous and discrete variables. Deterministic and stochastic systems (state machines and Markov models). Time response.

System identification (offline and online). Performance criteria and evaluation.

Design and simulation tools: Octave, Matlab/Simulink.

Projects: development of an applied project within the student interests including

- Modelling of a dynamical system
- Simulation
- Processing (visualization, control, prediction, or optimization of the modelled system)

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### **Declarative Languages Implementation (INF7171M)**

1. Declarative vs. Imperative Programming Languages
2. Implementation of Logic Languages
3. Implementation of Functional Languages
4. Implementation of Object-Oriented Languages

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### **Data Warehouse (INF7017M)**

1 Dimensional Modelling Primer

2 Introduction to Data Warehousing Systems:

- a. Fundamental concepts.
- b. The importance of Information in the organizations.
- c. Benefits and reasons to create a data warehouse system.

3 Data warehouse components.

4 Dimensional Model:

- a. Fact tables.
- b. Dimension tables.
- c. Association between fact tables and dimension tables.

5 Case Studies:

- a. Retail sales
- b. Inventory
- c. Order management
- d. Customer relationship management
- e. Telecommunications
- f. Education
- g. Health care

6 Data Warehouse Construction.

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### **Natural Language Processing Systems (INF7187M)**

(1) lexical analysis;

(2) Parsing: logic grammars (DCGs, XGS), tags, and HPSGs CFG.

(3) Semantic Analysis: DRT, and other semantic for natural language, compositionality.

(4) Pragmatic Analysis: Theory of speech acts, anaphora resolution, dialogue.

(5) Applications of natural language processing systems





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### **Machine Learning (INF7170M)**

General concepts on Machine Learning  
Supervised learning  
Decision tree induction  
Induction of classification rules  
Instance-based learning  
Bayesian learning  
Linear models  
Neural networks  
Evaluation of learning algorithms  
Unsupervised learning  
Evolutionary algorithms

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### **Ubiquitous Computing (INF7174M)**

Introduction to Ubiquitous Computing  
Wireless communication networks  
Mobile adaptive computing  
Data dissemination and management  
Context-aware computing  
Location-based services  
Systems for mobile platforms:  
Symbian  
Android  
iOS

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### **Game Design (INF7175M)**

The history of videogames  
Game design fundamentals  
Game balancing  
Level design  
Storyboard  
Game architecture  
Isometric games and sprite based  
Movement and control  
Interaction  
Artificial intelligence in games  
Mobile games and cross-media  
Future games  
The social-economic impact of videogames



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### **Declarative Information Systems (INF7178M)**

Heterogeneous information systems.

Middleware:

mediator languages,

logic-based models,

constraint systems,

persistence,

modularity.

Logic and object-oriented programming.

Object-relational databases.

Semantic web: XML, RDF, ontologies, OWL, query languages, SPARQL.

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### **Data Mining (INF7185M)**

1. Introduction: Machine learning and data mining

2. Classification problems

3. Naive Bayes

4. Decision trees

5. Instance based algorithms

6. SVM

7. Input: concepts, instances e attributes

8. Output: knowledge representation

9. Performance evaluation

10. Data Processing for "knowledge discovery"

11. Clustering

12. Data association

13. Visualization

14. Applications

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### **Computer-Based Decision and Control Systems (INF7186M)**

1. Closed Loop Feedback systems.

1.1. Linear discrete systems

1.2. Transforms and transfer functions

1.3. poles and zeros

1.4. closed loop systems

2. System supervision and fault detection.

2.1. Models Based

2.2. Signal Based

3. Project and simulation tools: Octave, Matlab/Simulink.

4. Implementation of and applied project.



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### **Reasoning and Knowledge Representation (INF7172M)**

- (1) Conceptual maps and semantic networks.
- (2) propositional descriptive logics
- (3) Formalization of Knowledge Bases
- (4) Ontologies
- (5) Descriptive Logic and Databases.
- (6) Time and causality
- (7) Semantic Web

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### **Software Engineering (INF7180M)**

- [Introduction / Motivation] Software engineering code of ethics
- [Software Requirements]
- [Software Design]
- [Software Construction] Model driven development: transformation from class diagrams to source code; programming by contract.
- [Software Testing] Fundamental concepts (e.g. verification, validation, objectives and taxonomy, test batteries, regression, IV&V, efficiency and effectiveness assessment); unit testing (whitebox) with regression; Test-Driven Development (TDD).
- [Software Maintenance] Model recovery from source code.
- [Software Configuration Management] Fundamental concepts (e.g. traceability, sandbox, baseline, check-in and check-out, deltas, branches, locks, differences, merges, rollback); characteristics of configuration management tools.
- [Software Engineering Management] Software engineering planning; software engineering project management.
- [Software Engineering Process] Agile development methods.
- [Software Quality]
- [Software Engineering Tools and Methods]

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### **Digital Signals Processing (INF7188M)**

- Discrete-time signals
- Discrete models and frequency representation
- FFT algorithm
- Digital filters: AR, MA, ARMA, low-pass, high-pass, band-pass
- Design and implementation of digital filters
- Cosine transform and modified cosine transform (vorbis)
- Signal modulation and demodulation (modem)
- Projects: audio compression, modem, audio effects processor, heart-rate monitor, echo cancelation.



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### **Human-Machine interfaces (INF7183M)**

Human-Computer Interaction (HCI): what, why, when?

Human and technological factors in HCI

Characteristics of interactive systems

Interaction models

Interaction styles

interaction paradigms

Usability principles

User and task analysis

Interaction design process:

Design Rules

Prototyping

Dialogs design

Screen design

Evaluation techniques

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### **Project Management (GES7182M)**

Module 1 - Project Management Framework

Basic concepts

Project Management Processes

Project life cycle

Module 2 - Team Organization and Management Project

The project manager

Organizational structure

Organization of the project team

Leadership in project management

Module 3 - Project Planning and Programming

Project objectives

Planning and the Work Breakdown Structure

Planning using PERT

Resource allocation, budget and project costs

Project viability

Module 4 - Monitoring, risk and project control

Earned Value Management (EVM)

Quality throughout the project

Project management and risk

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### **Advanced topics in Databases (INF7184M)**

Advanced SQL

Development "server sided- triggers, stored procedures, etc.

DBMS technologies

Evolution models of BD's: object relational, declarative, XML, etc.

Geographical and multimedia data

Data quality

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### **Seminars (INF7189M)**

R&D projects presented by IT companies; includes a seminar on "Research Methods".