



## Study Plan

**School:** School of Sciences and Technology  
**Degree:** Bachelor  
**Course:** Computer Sciences Engineering (cód. 155)

### 1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0900L	Linear Algebra and Geometry I	Mathematics	6	Semester	156
MAT0905L	Mathematical Analysis I	Mathematics	6	Semester	162
FIS0703L	General Physics I	Physics	6	Semester	158
LLT1232L	English I (Computer Science)	Non Available	3	Semester	75
INF0880L	Programming I	Informatics	6	Semester	162
INF0886L	Digital Systems	Informatics	3	Semester	83

### 1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0906L	Mathematical Analysis II	Mathematics	6	Semester	162
INF0862L	Computer and Systems Architecture I	Informatics	6	Semester	159
FIS0704L	General Physics II	Physics	6	Semester	158
MAT0925L	Introduction to Probability and Statistics	Mathematics	6	Semester	154
INF0881L	Programming II	Informatics	6	Semester	162

### 2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF0863L	Computer and Systems and Architecture II	Informatics	5	Semester	137
INF0864L	Databases	Informatics	6	Semester	157
INF0868L	Algorithms and Data Structures I	Informatics	6	Semester	162
GES0790L	Management	Management	5	Semester	135
MAT0932L	Discrete Mathematics	Mathematics	6	Semester	156
INF0882L	Integrated Project I	Informatics	2	Semester	37

### 2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF0866L	Computer Graphics	Informatics	6	Semester	160
INF0869L	Algorithms and Data Structures II	Informatics	6	Semester	157
MAT0929L	Computational Logic	Mathematics	6	Semester	156
INF0874L	Methods and Development of Software	Informatics	6	Semester	160
INF0887L	Operating Systems I	Informatics	6	Semester	159

### 3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF0873L	Formal Languages and Automata	Informatics	6	Semester	161
INF0879L	Declarative Programming	Informatics	6	Semester	162
INF0884L	Computer Networks	Informatics	6	Semester	160
INF0891L	Information Theory	Informatics	6	Semester	159



### 3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
<b>Group of Options</b>					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF0861L	Database Administration	Informatics	6	Semester	155
INF0876L	Production of Multimedia Content	Informatics	6	Semester	158
Group of Free Options					

### 3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF0870L	Artificial Intelligence	Informatics	6	Semester	157
INF0872L	Programming Languages	Informatics	6	Semester	160
INF0888L	Operating Systems II	Informatics	6	Semester	162
INF0865L	Compilers	Informatics	6	Semester	165
<b>Group of Options</b>					
Component code	Name	Scientific Area Field	ECTS	Duration	Hours
INF0861L	Database Administration	Informatics	6	Semester	155
INF0876L	Production of Multimedia Content	Informatics	6	Semester	158
Group of Free Options					

### Conditions for obtaining the Degree:

\*\*\* TRANSLATE ME: Engenharia Informática

Para obtenção do grau de licenciado em Engenharia Informática é necessário obter aprovação a 168 ECTS em unidades de curriculares obrigatórias e 12 ECTS em unidades curriculares optativas distribuídas da seguinte forma:

1º Ano

1º Semestre:

6 UC Obrigatórias num total de 30 ECTS

2º Semestre

5 UC Obrigatórias num total de 30 ECTS

2º Ano

3º Semestre

6 UC Obrigatórias num total de 30 ECTS

4º Semestre

5 UC Obrigatórias num total de 30 ECTS

3º Ano

5º Semestre

4 UC Obrigatórias num total de 24 ECTS

1 UC Optativa num total de 6 ECTS ou optativa livre que não da área científica de Informática

6º Semestre

4 UC Obrigatórias num total de 24 ECTS

1 UC Optativa num total de 6 ECTS ou optativa livre que não da área científica de Informática \*\*\*

## Program Contents



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### **Linear Algebra and Geometry I (MAT0900L)**

Systems of linear equations.

Matrices.

Determinants.

Vector spaces.

Linear applications.

Eigenvalues and eigenvectors. Jordan canonical form.

Geometry of plane and space.

Quadratic forms.

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### **Mathematical Analysis I (MAT0905L)**

Sequences and series.

Real functions of one variable.

Differential calculus.

Sequences and series of functions.

Integral calculus and applications

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### **General Physics I (FIS0703L)**

1. Introduction to Modern and Contemporary Physics

- Physics as Science: fundamental forces, physical laws and constants, models and orders of magnitude; main subjects of present Physics.

- Relativity: main concepts, speed of light.

- Quantum Physics: wave-particle nature of matter, quantization and Planck's constant; the photoelectric and Compton effects; the spectral lines.

- Present research on Physics: references to microscopic Physics, superconductivity and nanotechnology e applications; graphene.

2. Ondulatory Phenomena and Optics

- Harmonic oscillator; electromagnetic waves and waves in matter; the Doppler effect. Lasers.

- Geometrical optics: reflection and refraction; lenses and mirrors; optical devices. Interference and polarization.

3. Introduction to Thermodynamics

- Temperature scales.

- Kinetical Theory of Gases.

- Calorimetry and Zero Principle of Thermodynamics;

- 1st and 2nd Principles of Thermodynamics; entropy.



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### **English I (Computer Science) (LLT1232L)**

Section 1: Hardware:

The Workstation; The keyboard; Useful Verbs; The Mouse; Scanning; Useful Adjectives; Printing; Mobile Phones; Other Devices; Inside a Computer; Data Storage; Connectivity; Networks; Electronic Payments; Your Computer

\* Section 2: Software:

Using Software: Useful Verbs; The control Panel; Applications; Useful Adjectives; Word Processing; Image Editing; Graphic Design; Spreadsheets; Presentation Software; Problems with Software; Your Software

\* Section 3: The Internet

Internet browsers; Search Engines; Internet Terms; E-commerce; Internet Security; Email; Email Comprehension; Useful Verbs; Your Internet

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### **Programming I (INF0880L)**

Introduction: Basic notions of statement and algorithm, Basic notions of variable and expression

Control structures: Conditionals, Loops

Basic data structures: Lists, Dictionaries, Tuples

Abstraction mechanisms: Functions

Recursion

Applications

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### **Digital Systems (INF0886L)**

1. Numbering systems, numerical codes and arithmetic operations

2. Boolean algebra

a. Logic functions: AND, OR, NOT. Morgan Laws

b. Canonical form (sum of products of sums and products)

c. Algebraic simplification of logic functions

d. Karnaugh Maps

e. Logic functions: XOR, NAND and NOR

f. Synthesis of functions by the method of bridging

3. Combinatorial circuits

a. Half-adder circuits, adder, subtractor, comparator, multiplexer, demultiplexer, priority encoder, decoder

4. Synthesis of combinatorial circuits

5. Introduction to sequential circuits

a. Flip-flops: SR, D, JK, T

6. Synthesis of simple sequential circuits

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### **Mathematical Analysis II (MAT0906L)**

Topology and Sequences in  $\mathbb{R}^n$ .

Limits and continuity of functions in  $\mathbb{R}^n$ .

Differential Calculus of functions in  $\mathbb{R}^n$ .

Taylor Formula.

Inverse function and Implicit function.

Free extrema and Conditioned extrema.

Line integrals.

Multiple integrals.

Surface integrals.



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### **Computer and Systems Architecture I (INF0862L)**

General computer organization (cpu, memory, storage, peripheral devices).  
Memory organization and representation (bits, bytes, words, addresses, endianness).  
Instruction set architecture (ISA) of the MIPS processor.  
Low level programming (MIPS assembly).  
Program structure (text segment, data segment, heap, stack, etc).  
MIPS conventions (registers, functions, arguments, etc).  
Machine code.  
Integer and floating point (IEEE754) numbers.  
Introduction to virtual memory and memory hierarchy.  
Laboratory project: development of a MIPS assembly project.

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### **General Physics II (FIS0704L)**

1. Mechanics:
  - Review of da Kinematics;
  - Dynamics or the material point and of a system od points;
  - Conservation principles (Kepler's laws);
  - Movement in non inertial referentials;
  - Elementary dynamics of a rigid body.
2. Electromagnetism:
  - Electrostatics;
  - Gauss' law; Capacitors;
  - Electric current;
  - Study of DC circuits; RC Circuits;
  - Magnetic Field;
  - Electromagnetic induction; Maxwell equations.

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### **Introduction to Probability and Statistics (MAT0925L)**

1. Descriptive Statistics - Brief Review
2. Basic Probability Notions - Brief Review
3. Conditional Probability and Independence
4. Discrete and Continuous Random Variables
5. Discrete Random Vectors
6. The Most Important Families of Discrete and Continuous Probabilities Distributions
7. An Introduction to Sampling Theory
8. Statistical Inference (parametric and non-parametric)
9. Introduction to Simple Linear Regression
10. Some Non-Parametric Tests (Kolmogorov-Smirnov, Chi-Square, etc.)



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## **Programming II (INF0881L)**

I - Basics of Object Oriented Programming

Objects

Classes

Messages

encapsulation

II - The Java language

Java classes

variables and instance methods

method overloading

non instantiable classes

class hierarchy and inheritance

inheritance mechanism for classes definition

Dynamic lookup for methods

Inheritance vs class composition

abstract classes

Interfaces

Exceptions

Input/output, and streams

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## **Computer and Systems and Architecture II (INF0863L)**

Performance analysis. Microprocessor implementation. Control and datapath: single-cycle datapath; pipelining. Cache memory theory and operation: cache organisation; performance analysis. Virtual memory; performance analysis. Parallelism and multiprocessing. Storage systems: performance analysis.

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## **Databases (INF0864L)**

Introduction: Management System Database, Data Model, Languages of Databases.

Entity Relationship Model: Basic concepts (entity and relationship); Design of ER Model; constraints mapping; Clark, ER Diagram, Weak Entity; Extensions to the ER model; Model Reduction of an ER schema tables.

Relational Model: Structure of Relational Databases, Relational Algebra (operators) Extensions of Relational Algebra. Modification of the Database.

Languages manipulation of databases (SQL): Basic structure and set of SQL operations, Aggregate Functions, Modification of the base data and views, data definition language.

Database Integrity: Domain Restrictions, referential integrity, assertions and triggers, functional dependencies.

Database Normalization: Functional dependencies, Boyce-Cood, normal form and 3rd normal form.



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### **Algorithms and Data Structures I (INF0868L)**

#### 1. Introduction to algorithms analysis

- Spatial and Temporal Complexity
- Best case, worst case and expected case
- notations Big-O, Omega and Theta
- Analysis of iterative and recursive algorithms

#### 2. Abstract data types

- Lists, Stacks, Queues
- Trees
- Binary trees, binary trees traversals
- Binary search trees
- Perfectly balanced and balanced trees
- AVL Trees
- Priority queues: binary heaps, construction of a heap from a vector
- Hash tables: Collisions and its resolution

#### 3. The sorting problem

- Presentation, analysis and comparison of the behavior of some sorting algorithms: BubbleSort, Insertion sort, Mergesort, Heapsort, Quicksort and Bucketsort

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### **Management (GES0790L)**

- Entrepreneurship and Entrepreneur
- Management of Organizations
- Introduction to Financial Accounting
- Basic Concepts of Financial Analysis
- Introduction to Management Accounting
- Marketing
- Introduction to Financial Calculus
- Evaluation of Investment Projects
- Production and Stocks Management
- Strategic Management

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### **Discrete Mathematics (MAT0932L)**

1. Theory of sets
2. Combinatory
3. Theory of the numbers
4. Theory of the graphs and algorithms.

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### **Integrated Project I (INF0882L)**

This course has no specific syllabus, it uses the knowledge to be acquired in the course of the semester, as well as the previous semesters. Ties in with the remaining courses from this academic year.



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### **Computer Graphics (INF0866L)**

Context of Computer Graphics  
Computer Graphic 2D - Bases  
Computer Graphic 2D - Rendering  
Computer Graphic 3D - Bases  
Computer Graphic 3D - Contents  
Computer Graphic 3D - Geometric Transformations  
Computer Graphic 3D - Visualization  
Computer Graphic 3D - Illumination and Textures

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### **Algorithms and Data Structures II (INF0869L)**

Temporal and spatial complexity analysis. Dictionary abstract data type: red-black trees; trie; B-trees. Algorithms for pattern matching: naïve search; the Rabin-Karp algorithm; finite automata; the Knuth-Morris-Pratt algorithm. Graphs and graph algorithms: dense and sparse graphs; breadth-first walk; depth-first walk; topological sort; strongly connected components; minimum spanning tree; the Bellman-Ford and the Dijkstra algorithms. Data compression: variable size codes, Huffman codes; fixed size codes, the LZ families.

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### **Computational Logic (MAT0929L)**

1. Proposicional logic
  - 1.1 Syntax, semantics
  - 1.2 Truth tables
  - 1.3 Natural deduction
  - 1.4 Semantic Tableaux
  - 1.5 Normal forms, resolution
  - 1.6 Metatheory
  
2. First-order logic
  - 2.1 Syntax, semantics of Tarski
  - 2.2 Natural deduction
  - 2.3 Semantic Tableaux
  - 2.4 Normal forms
  - 2.5 Metatheory

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### **Methods and Development of Software (INF0874L)**

Presentation.  
Knowledge base revision and consolidation  
UML - An Introduction  
Structural components  
Use cases  
Components behavior  
OCL - Object Constraint Language  
Patterns





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### **Operating Systems I (INF0887L)**

Descrição das principais módulos e da arquitectura de um sistema operativo. Funções do sistema operativo

Gestão de processos

Escalonamento

Gestão de concorrência monitores e algoritmos de secção crítica

Gestão de memória

Sistema de ficheiros

Sistemas RAID

Desenvolvimento de sistemas operativos em software livre

Implementação de funções dum sistema operativo em ambiente simulado

Programação de aplicações usando serviços do sistema operativo

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### **Formal Languages and Automata (INF0873L)**

Basic concepts in formal languages. Finite specification of languages. Regular sets and expressions. Deterministic and non-deterministic finite automata (equivalence, automata minimisation). The Pumping Lemma for regular languages. Context free grammars (derivation trees and ambiguity, grammar transformation, Chomsky and Greibach normal forms, the Chomsky hierarchy). Push-down automata. The Pumping Lemma for context free languages. Non-deterministic parsing (top-down and bottom-up, breadth-first and depth-first) and deterministic parsing (LL(k), LR(k), LALR(k)). Basic notions in computability.

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### **Declarative Programming (INF0879L)**

Introduction and motivation

Logic Programming: Concepts, Prolog language, Logic Programming techniques

Introduction to functional programming: Basic types and definitions, Designing and writing programs, Data types

Programming with lists, Defining functions over lists, Generalization: patterns of computation, Functions as values.

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### **Computer Networks (INF0884L)**

OSI Model

Modulation

Codification

Error detection and error correction

Flow control

Medium Access Control Algorithms (MAC-sublayer), in wired and wireless networks

Routing

IP addressing

TCP - connections, flow and congestion control

Programming within the TCP/IP framework, using sockets.



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### **Information Theory (INF0891L)**

Historical background e application areas. Review of basic notions of probability and statistics.

Basic concepts of information theory.

Data compression.

Shannon-Fano-Elias coding. Entropy rate. Properties (for stationary Markov processes).

Definition of a discrete memoryless channel and channel capacity.

Channel capacity of some channels.

Continuous random variables.

Relation between the continuous and discrete case. Analog-Digital (AD) and Digital-Analog (DA) conversion.

Data compression algorithms.

Channel coding algorithms.

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### **Database Administration (INF0861L)**

1. Database, Data and System Administration

2. Data modeling. Logical and physical models

3. Database performance design

4. Application design

5. Database design reviews

6. Data availability

7. Performance management

8. Data integrity

9. Database security

10. Database backup and recovery. Disaster planning

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### **Production of Multimedia Content (INF0876L)**

Multimedia data types

Multimedia data manipulation

Tools for building multimedia applications

Prospects for future development (mobility, context)



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### **Artificial Intelligence (INF0870L)**

(1) Introduction to Artificial Intelligence.

- 1.1. Areas of AI
- 1.2. History of AI.
- 1.3. Current Research Topics.
- 1.4. Introduction to rational agents.

(2) State space search

- 2.1. Problem solving
- 2.2. State-Space. Actions as transition states operators. Formulation of problems as state space searches.
- 2.3. Non-informed Search: bread first search, depth search, limited depth first search, iterative depth search and bidirectional search.
- 2.4. Temporal and spatial complexity analysis.
- 2.5. Definition of complete algorithm and optimal algorithm.
- 2.6. Informed Search . Algorithms: best first search, greedy search and A \* search. Definition of admissible heuristic. Study of A \* for admissible heuristics. Definition of admissible heuristics for some problems. Other strategies for search in the state space.
- 2.7. Constraint satisfaction problems: design and alternative resolution methods.
- 2.8. Local search: Hill climbing, simulated anealing and genetic algorithms.
- 2.9. Formulation of probl

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### **Programming Languages (INF0872L)**

1. Computability and programming languages
2. Lambda calculus
3. Denotational semantics
4. Systems and type inference
5. Activation records
6. Exceptions
7. Concepts of object oriented languages: inheritance and subtypes
8. Implementation of object oriented languages

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### **Operating Systems II (INF0888L)**

- Distributed Systems' Properties
- Interaction Models
- Communication in Distributed Systems
- Distributed Objects and Remote Invocation
- Security
- Distributed File Systems
- Naming and Directory Services
- Clock Synchronization
- Mutual Exclusion and Transactions in distributed context
- Replication
- Technologies: Web Services, Java RMI, JDBC, Web Applications with Servlets and JSPs



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## **Compilers (INF0865L)**

1. Introduction
2. Lexical analysis
3. Syntactic analysis
4. The VSPL language
5. Abstract syntax
6. Dictionaries (symbol tables)
7. Semantic analysis (names and types)
8. Activation records
9. The SiM stack machine
10. Code generation for SiM