UNIVERSIDAD DE BURGOS

COURSE DESCRIPTIONS

Bachelor's Degree in Computer Engineering

➢ 1st year

6344 DEONTOLOGICAL AND LEGAL FUNDAMENTALS OF ICT'S

LEGAL BLOCK

Introduction to the legal framework. General concepts, perspectives.
Commercial regulation.
Intellectual Property.
Data protection.
Computer crimes.

PROFESSIONAL ETHICS BLOCK

Ethical concepts. Moral behaviour in ICTs.
Computer crimes. Moral concepts and principles of professional ethics.
Privacy and security in ICTs from the perspective of professional ethics.
Emerging changes brought about by social networks and the evolution of ICTs.

6345 LINEAR ALGEBRA

Basic notions
-Linear systems. Gauss method for solving systems.
-Matrices. Gauss method for obtaining the inverse matrix. Rank of a matrix.
-Determinants. Gauss method for the calculation of determinants. Determinants and systems of equations.

Vector spaces.
-Real vector space. Subspaces.
-Linear combination: linear dependence and independence.
-Generating set, bases and dimension. Coordinates and base change.

Euclidean vector spaces.
-Inner product. Standard and distance. Angles and orthogonality.
-Orthonormal base changes: Orthogonal matrices.

Linear applications and diagonalization.

-Concept of linear application and properties. Image and nucleus of a linear map. Matrix and equations of a linear map. Similarity of matrices.

-Eigenvalues and Eigenvectors. Characteristic polynomial. Diagonalization.

6346 BASIC COMPUTING

Unit A: Introduction to Computer science

1 Basic concepts.

Information coding, computer architecture.

2 Introduction to Operating Systems.

3 Introduction to computer networks and the Internet.

4 Introduction to Programming.

5 History of Information Technology.

Unit B: Use of basic tools

6 Spreadsheets.

7 Word processing.

8 Presentations.

6347 PHYSICS FOR COMPUTER SCIENCE

1.- Electric Field

1.1 Electrical load.

1.2 Coulomb's Law.

1.3 Electric Field.

1.4 Continuous load distribution.

1.5 Gauss's Law.

2.- Electrical Potential

2.1 Work and energy (review).

2.2 Electrostatic potential energy.

2.3 Electrical Potential.

2.4 Relationship between electric field and potential.

3.- Conductors and dielectrics

3.1 Conductors, insulators and semiconductors.

3.2 Conductors in electrostatic equilibrium.

3.3 Capacitors.

3.4 Capacitor combinations.

3.5 Energy of a capacitor.
3.6 Behaviour of a dielectric in an electric field.

4.- Electric current
4.1 Electric current.
4.2 Ohm's Law.
4.3 Resistance grouping.
4.4 Energy in direct current circuits. Electromotive force.
4.5 Circuit analysis: Kirchhoff Rules.
4.6 Instruments for electrical measurements.
4.7 RC circuits.

5.- The magnetic field
5.1 The magnetic field. Field lines.
5.2 Force exerted by a magnetic field.
5.3 Moment exerted on current coils and magnets.
5.4 The Hall effect.
5.5 Sources of magnetic field.
5.6 Force between two parallel conductors.
5.7 The magnetism of matter.

6.- Electromagnetic induction
6.1 Magnetic flux.
6.2 Induced electromotive force and Faraday law.
6.3 Electromotive force of movement.
6.4 Self-induction.
6.5 Magnetic energy.

7.- Alternating current
7.1 Introduction: Direct current and alternating current.
7.2 Sine emf generator.
7.3 Characteristics of alternating signals. Effective quantities.
7.4 Alternating Current Circuits.
7.5 Impedance Association.
7.6 Power in alternating current.
7.7 The transformer.

8.- Electromagnetic waves and introduction to solid state physics
8.1 Electromagnetic waves.
8.2 Structure of a semiconductor crystal.
8.3 Energy levels.
8.4 Power bands.

8.5 Donor and acceptor Impurities.
8.6 Semiconductor joints and devices.

6348 DISCRETE MATHEMATICS

Logic and binary relationships.
Logic and sets.
Logic. Truth tables. Algebra of propositions. Reasonings and rules of inference. Theorems and demonstrations. Sets, operations with sets.
Algebra of logical variables.
Variables and logical functions. Binary Boolean Algebra. Standard forms. Logic gates.
Karnaugh Maps.
Binary relations and applications.
Equivalence relations, order relations. Applications.
Counting techniques. Integers.
Combinatorial.
Fundamental principle for counting, Dirichlet distribution principle and inclusion-exclusion
Variations. Permutations. Ordinary combinations.
Combinations with repetition. Combinatorial numbers and properties. Newton's Binomial.
Some other elemental counting techniques.
Integers. Induction principle.
Mathematical induction Principle. Divisibility and prime numbers. The fundamental theorem of arithmetic.
Congruence of integers.
Recurrence relations. Graphs.
Recurrence relations.
Linear recurrence relations with constant coefficients. Examples. Solution of recurrence relations: method of indeterminate coefficients and method of generating functions.
An introduction to graph theory.
Introduction: The problem of the seven bridges of Königsberg. Graphs and their representation. Some special types of graphs. Connection. Eulerian graphs.
Hamiltonian graphs. Tagged graphs. The problem of the shortest path. Trees. Trees with roots. The problem of the minimal network.

6350 CALCULUS

Functions real variable
Real functions of real variable, limits.
Continuity and derivability.
Graphical representation of functions.
The definite integral.

Graphical representation of functions.

Successions
Successions and series.
Taylor development, power series.

Numerical calculation
Polynomial interpolation, derivation and numerical quadrature.

Multi-variable functions
Multi-variable functions, limits.
Continuity and derivability.
Multiple Integrals.

6351 PROGRAMMING

Unit A: Introduction to Programming
Topic 1: Introduction to a programming language.
Topic 2: Simple data and its operations I: natural and integer numbers.
Topic 4: Simple data and its operations II: enumerations, characters, numbers with decimals.

Unit B: Structured programming
Topic 3: Modular programming I: Functions.
Topic 5: Control Structures I: Sequential and Alternative Sentences.
Topic 6: Modular programming II: Recursive functions.
Topic 7: Control Structures II: Repetitive Sentences.

Unit C: Composite data and algorithms
Topic 8: I/O operations with text files.
Topic 9: Homogeneous data I: Data tables and operations with tables.
Topic A: I/O operations with binary files.
Topic B: Homogeneous data II: Character strings and string operations.
Topic C: Heterogeneous data: Registers and unions and their operations.
Topic D: Basic algorithms.

6352 COMPUTER FUNDAMENTALS

COMPUTER FUNDAMENTALS
VON NEUMAN ARCHITECTURE
Reference architecture in digital computers.

Historical evolution.
CPU, Central Processing Unit.
Introduction.
Control unit work.
The control unit inside the computer.
Types of control units.

MEMORY UNIT
Introduction.
Main memory parameters.
Memory management.

INPUT-OUTPUT SYSTEM
Introduction.
Direct communication through the bus.
Management of input-output systems.
Specific I/O systems.

6353 OPERATING SYSTEMS

Introduction
1. What is an Operating System?
2. History of Operating Systems.
3. Operating System Concepts.
4. Structure of OSs.

Processes
Introduction to Processes.
1. Introduction.
2. Communication between processes.
3. Problems of communication between processes.
4. Processes in Unix.
5. Process planning.
6. Synchronization of processes.

Blocks
Introduction to Blocks
1. Resources.
2. Blocks.
3. Ostrich Algorithm.
4. Detection and recovery of blockages.

5. Avoidance of blockages.
6. Prevention of blockages.

Memory

Memory Management.

1. Administration without exchange or pagination.
2. Exchange.
3. Virtual memory.
4. Page replacement algorithms.
5. Modelling of pagination algorithms.
6. Design aspects for pagination systems.
7. Segmentation.

Input / Output

Introduction to Entry / Exit.

1. Interruptions.
2. I/O Hardware Principles.
3. Principles of I/O Software.
4. Discs.
5. Clocks.

➢ 2nd year

6354 PROGRAMMING METHODOLOGY

A. Modularity

1. Introduction to Object-Oriented Programming.

B. Classes and Objects

2. The static structure: Class.
3. The dynamic structure: Object.

C. Inheritance and Genericity

4. Inheritance.
5. Genericity.

D. Robustness.

6. Defensive Programming and Exception Treatment.
7. Design by Contract.

E. New Techniques

8. New Programming Techniques and Paradigms.

6355 STATISTICS

Descriptive statistics
Statistical description of a variable.
Joint description of two variables.

Probability and Random Variables
Probability. Discrete random variables. Continuous random variables. Probability distribution models. Sampling Distributions.

Inferences on a population
Random and Statistical Samples. Specific estimation. Confidence intervals and hypothesis contrasts on normal populations and on proportions. Normality Contrasts.
Non-parametric methods.

Inferences on the comparison of two populations
Intervals and contrasts for the comparison of two independent normal populations. Comparison of two proportions. Non-parametric methods.

Linear regression models
Simple regression. Box-Cox transformations.

Variance analysis techniques
Analysis of variance with a factor. Introduction to experimental design. Designs
Factorials at two levels.

6356 SOFTWARE ENGINEERING

UNIT 1: INTRODUCTION TO SOFTWARE ENGINEERING
Topic 1. Introduction to Software Engineering and Software Systems
Information.
It covers ideas and notions of Software Engineering, such as: What is it? Who does it?
Why is it important?
Topic 2. Software Life Cycle and Software Development Methodologies.
It covers ideas and notions of Software Engineering, such as: What are the steps? What is the product obtained? How can you ensure that it has been done correctly?

UNIT 2: REQUIREMENTS ENGINEERING
Topic 3. Analysis and specification of requirements in Software Systems.
Requirements engineering establishes a solid basis for design and construction.

Without it, the resulting software has a high probability of not meeting the customer's needs. Pre-requisites are identified for the design and construction of a system.

UNIT 3: SOFTWARE ANALYSIS AND DESIGN

Topic 4. Software Analysis and Design.

Software Analysis and Design models are created to gain a better understanding of the real entity that will be built. Models must represent the information that the software transforms, the architecture and functions that allow the transformation to occur, the characteristics that users want, and the behaviour of the system as the transformation takes place.

UNIT 4: SOFTWARE TESTING

Topic 5. Introduction to Software Testing Techniques

It indicates how tests are performed to discover errors in the design and construction of the software.

6357 DATABASES

Introduction to Databases

Definitions

What is a DBMS? What is a DB?

Historical Evolution of DBs

File systems and their problems. Legacy systems and physical dependence. The ANSI/SPARC reference model. Modern database systems.

Data Models and Abstraction Levels

Fundamentals of the Relational Model

Basic concepts of the Relational Model

Relationship, tuple, attribute, domain, super key, key.

First Form Normal Restriction

External Keys and Restriction of Referential Integrity

First Steps with SQL

SQL language and script programming

Basic SQL commands and SQL data types.

DDL Commands, DML INSERT Commands - VALUES, Basic SELECT (WHERE and ORDER BY), DELETE, UPDATE, massive INSERT, CREATE TABLE AS SELECT.

Views with SQL

Relational algebra and its equivalent representation in SQL

Introduction to the operators of relational algebra
Selection, projection and operations of assemblies.
Renaming Attributes
Renamed in Algebra and SQL.
Cartesian Product
Cartesian product in algebra and SQL.
Theta-Join
Theta-join in algebra and SQL.
Natural Join
Natural Join in algebra and SQL.
External Join
External Join in algebra and SQL.
The relational quotient
Relational quotient, decomposition into elementary operations, quotient into SQL.

Introduction to Normalization
Problems of relational representations with information redundancy.
Abnormalities in high lows and modifications, loss of information.
Normal shapes.
The First Normal Form, Functional Dependencies, Super keys and Keys, Second Normal Forms, Third and Boyce-Codd.

The E/R model and its logical representation in SQL
Review of the basic concepts of the E/R model
Basic concepts of the E/R Model seen in the Software Engineering course (Entities, Attributes, Binary Interrelationships, Cardinals).
SQL representation of binary relations.
1:1, 1:N and N:M. Reflective interrelationships, dependencies by existence and identification.
Higher-level interrelationships in the E/R model.
Justification. Cardinals of Chen in the ternaries. N:M:P, N:M:1, N:1:1 and1:1:1
Representation in the diagram and step to SQL tables. The ternaries as a form of modelling the time dimension in the E/R diagram.
Aggregations in the E/R model
ISA Interrelationships in the E/R Model
E/R Representation. Types of ISA. Discriminants. Step to tables as 1:1 relationships, Advantages.
SQL queries on schemas with ISAs.

The DML of SQL in depth
Fork constructions CASE

Manipulation of null values
Trivalent logic, external join revision, COALESCE function.
Logical tests.
BETWEEN, LIKE, regular expressions, IN.
Aggregation Functions.
COUNT, SUM, AVG, MIN and MAX.
GROUP BY and HAVING.
GROUP BY and HAVING clauses, external joins with groupings.
Non-correlated sub-consultations.
Clauses that support subqueries (SELECT, FROM, WITH, WHERE, and HAVING). Sub queries in the FROM and nesting of aggregation functions. Sub queries in the SELECT, the WHERE and the HAVING that return one or zero rows vs. those that Null in test IN and ALL. Quotient by subqueries in the HAVING.
Correlated sub-consultations
Syntactic elements of correlated sub consultations, semantic interpretation of Case study: correlated sub-consultations in SELECT, in the The EXISTS test and the correlated sub-consultations.

6358 COMPUTER ARCHITECTURE

Block I: SCALAR PROCESSORS
Computer Architecture.
Architecture of the repertoire of instructions.
Performance evaluation.

Block II: BENEFIT INCREASE TECHNIQUES
Segmented processors.
Advanced monoprocessing architectures.

Block III. MEMORY HIERARCHY
Main memory.
Cache memory.
Virtual memory.

Block IV: INPUT AND OUTPUT
Input/output system.
Input/Output Buses.
Management of input-output system.

6359 DATA STRUCTURES

Abstract Data Types.
Algorithms: Introduction.

Linear Structures: Piles, Queues and Lists.
Sets and Tables.
Tree structures.
Graphs.

6360 COMPUTER NETWORKS

Networks.
Introduction to Networks.
The Physical Level.
The Linking Level and Local Networks.
The Network Level.
Transport Level.
Application Level.

6361 HUMAN COMPUTER INTERACTION

Introduction to Human-Computer Interaction (MMI).
Man and the IHM.
Mental Models.
Design Process.
Analysis of users and tasks.
Design principles.
Style Guides.
User Support.
Internationalization of interfaces.
Tools.
Evaluation.

6362 FUNDAMENTALS OF ENTERPRISE MANAGEMENT

Introduction to the company
The company and the entrepreneur.

Company management
The management of the company and the management process.
Development and growth of the company.

Human Resources
Introduction to the company's human resources.

Financial subsystem in the company and accounting
Introduction to financial functioning of the company and to Accounting.
Introduction to investment-financing decisions in the company.
Commercial subsystem.
Introduction to the business management.
The Marketing-mix.
Current trends in business management.
Current trends in business management and Business models.
Creation of companies.
Entrepreneurs.

6363 SYSTEMS ANALYSIS AND DESIGN

UNIT 1
Topic 1. UML as a Modelling standard.
Topic 2. Specification of the System with UML.

UNIT 2
Topic 3. The Unified Process of Software Development.
Topic 4. Design patterns. General software Patterns for the assignment of Responsibilities (GRASP).

UNIT 3
Topic 5. Project Management and Planning.
Topic 6. Perspective of the Software Engineering Process. Temporary planning.

➢ 3rd year

6364 PARALLEL ARCHITECTURES

Introduction.
Introduction to parallel architectures: hardware and programming

Memory sharing
Shared memory multiprocessors.
Memory sharing.
Coherence of cache.

Distributed memory
Distributed Memory Multicomputers.
Introduction.
Switching.
Routing.

Interconnection systems
Interconnection Networks.
Static topologies.
Dynamic topologies.
Modern routers.

Programming of advanced architectures
Programming of parallel architectures.
Operating system level.
Application Level.
Management level.

Architecture
Commercial architectures.
Real multiprocessors and multicomputers.
Clusters.

Parallel programming practices
Introduction to MPI Programming.
MPI Basic Programming Course.
Parallel programming.
MPI Advanced Programming Course.

6365 INTELLIGENT SYSTEMS

Introduction.
Problems and state space.
Search.
Introduction to knowledge representation.
Logic.
Other intelligent system techniques.
Implementation of algorithms for the construction of intelligent systems.

6366 PROJECT MANAGEMENT

UNIT 1: Classic project management

T1. Project definition.
T2. The project plan.
T3. Time management (Gantt, CPM, PERT, Roy).
T4. Cost management.
T5. Other processes in DIP.
T6. Monitoring and control. Earned value method.
T7. Basic computer tools in project management (MS Project and free native alter).

UNIT 2: Agile project management

T1 Agile project management.
T2 Introduction to the Agile model for software development.
T3 Roles and responsibilities of the project.
T4 The elements.
T5 Meetings.
T6 Measurement.
T7 Good development practices for agile projects.

6367 SYSTEMS AND NETWORK DESIGN AND MANAGEMENT

Introduction to the administration and management of systems and networks.
Administration of operating systems.
Network services.
Optimization of systems.
Network design.
Network management.
Quality of services.

6368 LANGUAGE PROCESSORS

Introduction

What is a language processor?
Phases of a compiler.
T-Diagrams and Cross Compilation.

Lexical analysis
Regular Expressions.
Finite Automaton.
Obtaining finite automaton from regular expressions.

Syntax analysis
Introduction to syntactic analysis.
Descending syntactic analysis.
Ascending syntactic analysis.

Semantic analysis
Inherited and synthesized attributes.
Syntax-driven translations.
Concordance of types.

Memory management and code generation
Execution environments.
Generation of code for expressions.
Code Generation for Control Structures.
Generation of code for access to matrices.
Code Generation for Boolean Statements.

Tools for automatic generation of analysers
Generators of lexical analysers.
Descending Syntactic Analyzer Generators.
Ascending Syntactic Analyzer Generators.

XML Document Analysis
Format of an XML document.
The SAX XML Analysis API.

6369 CONCURRENT AND REAL TIME PROGRAMMING

Unit A: Concurrent Programming
Basic concepts
-Introduction.
-Basic structures to support concurrency in Java.
Threads, life cycle, priorities, interruptions, states, executors.
-Objects and concurrence.
Concurrency, structures for concurrent execution, concurrency and scheduling

OO, transformations and object models.
- Concurrent Design Impositions.
Safety vs. liveliness, performance vs. reuse.

Mutual Exclusion
- Introduction.
- Immutability.
Applications and construction.
-Synchronization.
Ways to achieve synchronization, fully synchronized objects, collection travel strategies, singleton, interlocking, atomicity.
- Confinement.
Through methods, within threads, objects, groups
- Design patterns:

State Dependencies
- Introduction.
- How to deal with faults.
Exceptions, Cancellation.
- Protected methods.
Protected suspension, monitor operation, protected waits and notifications, more types of waits and notifications.
- Use of Java libraries.
- Concurrent design patterns.
Producer - Consumer, Read and Write Blocking.

Unit B: Real-time programming
Introduction to Real-Time Systems.
Real-time programming.
Real-time Planning.

6370 INFORMATION SYSTEMS SECURITY

1. Introduction to the problem of computer security.
2. Physical Security.
3. Personal Computer Security.
4. Security in Operating Systems.
5. Viruses and other programmed threats.
6. Cryptography.
7. Network and Internet Security.
8. Risk Analysis and Planning.

9. Techniques and products for Security.
10. Legal and ethical scope in relation to Computer Security.

6371 DATABASE APPLICATIONS

Form and Report Generators

Oracle Environment

Introduction to Oracle (Express Edition), associated tools such as SQL*Plus,
SQL Developer and Application Express web application development environment
(APEX): structure, roles, workspace and administration.

Forms and reports

Block A. Application Builder. Logic and flow. Components: Pages, regions, items
Navigation: breadcrumbs, navigation bar and lists.
Buttons, links and substitution chains.
Block B. Forms and reports. Creation of pages. Simple, tabular and
Reports and graphics: SQL, interactive and for printing.

JDBC as a case study of API connectivity with databases.

Introduction to JDBC.
Historical origins. The JDBC driver, types of JDBC drivers.
The connection to the DB.
Connection vs. DataSource. Using JNDI for connection.
Definition and use of a Connection Pool.
SQL commands from JDBC
Basic ResultSets. Data conversions between java and SQL. Manipulation of strings to parameterize sentences. Navigation through scrollable ResultSets. Operations
DML from JDBC.
Optimize performance.
Prepared Sentences. Cache of Prepared Sentences. Batch mode.

Transactions

Presentation of Transactions.
Commit, Rollback, Autocommit. Situations of implicit rollback and implicit commit.
Treatment of exceptions and rollback.
ACID Database Properties
Presentation of ACID properties. Symptoms of loss of insulation. SQL isolation support. Isolation from JDBC. Detailed study of the READ COMMITED and SERIALIZABLE levels.
Isolation Implementation Techniques.
Row blocking situations according to the insulation level. Presentation of instantaneous isolation and multiversion concurrency control.

Sequences.
Sequences and their justification from the public's point of view. Use of
CURRVAL in other people's passwords.
Programming of transactions.
Transform SELECT + UPDATE/DELETE transactions into transactions with only
Transaction chopping, use of transaction chopping combined with batch mode.
Rollback situations. Exception treatment. Optimistic programming of the transaction.
ResultSets and transactions.
navigable and updatable ResultSets. Sensitivity of ResultSets.

Stored procedures
Introduction.
Definition of Stored Procedures. Advantages of Stored Procedures.
Historical overview and the PSM standard.
The PL/SQL Language
PL/SQL blocks, scope and visibility of variables, bifurcation and repetitive instructions, declarations by reference.
Procedures and functions PL/SQL.
Declaration of functions and procedures, declaration and types of parameters, handling of exceptions.
Interaction with the Database from PL/SQL.
DML update, SQL%ROWCOUNT, transactions, implicit and explicit cursors. Cursor properties.
Use of procedures stored from a JDBC Callable Sentences database API.

Triggers
Introduction to Active Databases
Active Databases and ECA rules. Usefulness of ECA rules.
Syntax and Semantics of Triggers in Oracle
General presentation of possible events. Triggers sensitive to DML events, BEFORE/AFTER trigger times.
Granularity of row and sentence. Reference variables OLD and NEW. Trigger manipulation (CREATE/DROP/ALTER), activation and deactivation.
Transactions in Oracle Triggers.
Generic treatment of transactions, the special case of stand-alone transactions.
Extension of PL/SQL for advanced triggers programming.
Arrays and registers in PL/SQL.
Packages. Implementation of session variables via packages.
Mutant Table and Compound Triggers Error in Oracle.
Description of the mutant table problem. Solution of the mutant table problem by compound triggers.
Non-termination problem.
Recursive calls between triggers. Conservative analysis of the non-completion problem.

Frameworks for Persistence
Frameworks for Persistence.

Introduction to the problem of Impedance Mismatch between the object model and the relational model in databases. Patterns in application architecture. DAO design pattern and use of ORM as a final solution.
JPA: Entities.
Introduction to JPA as a specification for persistence frameworks. Definition of persistent entities. Access to Attributes and Properties. Java types. Loading attributes. Embedded classes. Primary Keys: simple and compound. Listed Types.
Transient Data
JPA: Relationships
Definition and mapping of relationships in the entities. Relationships between Entities:
Many to One, One to One, One to Several, Many to Many. Data Loading: Anxious vs. Lazy. Derived Keys. Embedded Classes (Review). Use of Collections.
Inheritance and Operations in Relationships.
JPA: Entity Manager
Characteristics of an entity manager. EntityManager interface. Concept of persistence unit. Entity life cycle.
Making entities persistent. Finding and eliminating entities. Uncoupling and mixing entities.
Synchronization with the database. Interceptors, EntityListener and listener inheritance. Validation and Utility Classes.
JPA: Queries
Definition of queries with persistence frameworks. JP QL. Definition of queries with JP QL. Return of queries. Pagination support. Queries with inheritance. Bulk Update and Delete. Native queries. Criteria API. Classes of CriteriaBuilder / CriteriaQuery. Root of the query and Navigation. WHERE clause, expressions, ordinations and groupings.
Query Execution. Comparison JP QL vs. Criteria API

JPA: Transactions and Concurrency
Study of transactions with JPA and problem of concurrence with the different levels of blocking: optimistic vs. pessimistic. Cache management.

6372 ALGORITHMS

Algorithm Analysis.
Voracious algorithms.
Divide and Conquer.
Dynamic Programming.
Computational Complexity.
Approximate Algorithms.

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6373 NUMERICAL METHODS AND OPTIMIZATION

UNIT 1 NUMERICAL CALCULATION

TOPIC 1: NUMERICAL SOLVING OF EQUATIONS

Introduction to the different types of errors that appear in Applied Mathematics.
Numerical solving of nonlinear equations.
Exposure and implementation of some numerical algorithms to solve equations.
Dimensioning of errors.

TOPIC 2: NUMERICAL SOLVING OF LINEAR SYSTEMS.

Numerical Solving linear systems.
Exposure and implementation of some numerical algorithms.
Dimensioning of errors.

TOPIC 3: GLOBAL INTERPOLATION

Different ways to build global interpolation polynomials with different types of data.
Dimensioning of errors.

TOPIC 4: SEGMENTAL INTERPOLATION

Polynomial functions in pieces. Different types of segmental interpolation with different types of data.
Introduction to cubic splines.
Dimensioning of errors.

UNIT 2 OPTIMIZATION THEORY

TOPIC 5: INTRODUCTION TO LINEAR PROGRAMMING

Introduction to Optimization with and without restrictions. Introduction to Linear Programming.
Presenting the problem: different formulations. Graphic Resolution.
Types of solutions. Convex sets. First form of general resolution.

TOPIC 6: THE SIMPLEX METHOD

The Simplex algorithm: Start of the algorithm. Passing from one end to the other. Output and input criteria. Algorithm Continuation.
Different resolution examples.
Sensitivity analysis. Interpretation of the results report. Variation of the coefficients of the objective function and of the independent term. Shadow prices and reduced costs.

TOPIC 7: STANDARD MODELS OF LINEAR PROGRAMMING

Linear Programming Models: The Problem of Task Assignment, the Problem
of transportation, the problem of Maximum Flow, the problem of the shortest Route.

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➢ 4th year

6374 COMPUTER CONTROL

Computer Control.
Introduction to control systems.
Representation and modelling of dynamic systems.
Analysis and design of continuous control systems.
Computer control systems.
Discretization and reconstruction of signals.
Analysis and design of discrete control systems.

6375 DIGITAL SYSTEMS DESIGN AND IMPLEMENTATION

HARDWARE DESCRIPTION LANGUAGES
Programming in VHDL.
Language syntax.
Data types.
Entity.
Language architecture.
Subprograms: procedures and functions.
Bookstores, packages.
Synthesis in VHDL.
Design and implementation in programmable logic devices.
Simulation.
Simulation of systems in VHDL.

COMBINATION SYSTEMS
Basic Elements.
Multiplexers.
Decoders...

SEQUENTIAL SYSTEMS
Flip-flop.
Basic memory element.
Registers and counters.
Fundamental elements of any design.
Analogies in VHDL with for and if instructions.

PRACTICAL PROGRAMMING IN VHDL

Practices: Data Flow Architecture.
Study, analysis and programming of a data flow architecture.
Concept and programming of Block.
Practices: Algorithmic architecture.
Study, analysis and programming of serial or algorithmic architecture.
Practices: Procedures and functions.
Study, analysis and programming of procedures and functions. Application to structured programming.
Practices: Synthesis.
Application of a VHDL program to an FPGA or CPLD circuit.

6376 TESTING AND VALIDATION

Unit A. General theory of validation and testing

Topic 1. Introduction to Software Validation and Testing.

Unit B. Testing techniques and strategies

Topic 2. Black Box Testing.
Topic 3. White box testing,
Topic 4. Integration, system and acceptance tests.
Topic 5. Evidence-led development.

Unit C. Testing Tools

Topic 6. Test Automation Frameworks.
Topic 7. Libraries for Software Testing.
Unit D. Testing in different paradigms.
Topic 8. Techniques dependent on the programming model.

6377 INFORMATION MANAGEMENT

Information management and information systems.
Approach to the management of information from the Economy, the Management Sciences, Ethics and Law.
Integrated information systems: ERP.
Business Process Modelling Notation (BPMN).
Supply Chain Management (SCM).
E-commerce and Google Adwords.
Recommendation systems.
Python and data management packages: Numpy, Pandas, Matplolib.

6378 SOFTWARE MAINTENANCE AND DESIGN

Introduction to design patterns.
Creative patterns: abstract factory, builder, manufacturing method, prototype, unique instance.
Structural patterns: adapter, bridge, composite, decorator, composite, façade.
Behaviour patterns: command, interpreter, iterator, mediator, observer, state, strategy, method template.

6379 ENTERPRISE MANAGEMENT

Company and Market.
Advanced methods in the financial subsystem.
The productive subsystem.
Other company sub-systems.

6380 COMPUTER EQUIPMENT MAINTENANCE

INTRODUCTION TO MAINTENANCE
Types of maintenance.
Environmental factors.
Reliability of computer systems.

COMPUTER SUBSYSTEMS
Current microprocessors: architecture, configuration and maintenance.
Memory: Memory: Technologies, architecture, configuration and maintenance.
Motherboard: Technologies, architecture, configuration and maintenance.
Computer power supply.
Storage: Technologies and architecture, configuration and maintenance.

6381 APPLICATION SPECIFIC HARDWARE

UNIT 1
MICROCONTROLLERS.
UNIT II
GRAPHICS PROCESSORS.
UNIT III
SIGNAL PROCESSORS.
UNIT IV
PROGRAMMABLE LOGIC DEVICES.

6382 NEURAL AND EVOLUTIONARY COMPUTATING

Introduction to Neuronal Computing
Introduction.
Introduction to Neuronal Computing.
Human Neural Processing.
Artificial Neural Networks.
Artificial Neuron.
Neuron model.
Activation functions.
Types of activation functions.

Artificial Neural Network
Artificial Neural Network.

Apprenticeship
Supervised Learning.
Supervised Learning.
Introduction to Evolutionary Computing.
Introduction to Evolutionary Computing and Learning.

Genetic Algorithms
Basic Concepts of Genetic Algorithms.
Problems encountered by Genetic Algorithms.
Evaluation and Scope of Genetic Algorithms.

Areas of Application of Evolutionary Computing
Problems with Multiple Objectives.
Advanced Evolutionary Algorithms.

6383 OPERATING SYSTEMS PROGRAMMING

- Introduction to Operating Systems.
- Management of files and directories.
- Processes. Communication and synchronization.
- Threads. Communication and synchronization.
- Network Communications.
- Introduction to Distributed Systems.

6384 DISTRIBUTED SYSTEMS

A. Introduction, concepts and fundamentals of Distributed Systems
Introduction to Distributed Systems.
System Models.

B. Middleware: evolution in paradigms
Communication between processes.
Distributed objects and remote invocation.

C. Web Programming
Server programming.
Customer Programming.

D. Distributed algorithms
Time and global states.
Coordination and agreement.

E. Distributed data
Replication and Fault Tolerance.
Distributed Transactions.

F. Intelligent agent systems

6385 EMBEDDED AND REAL TIME SYSTEMS

Part I. Introduction and requirements of embedded systems for digital control
1. Introduction to Embedded Systems.
2. Digital control review (sampled systems, Z transformed, discrete systems analysis, equations in differences, etc.).
3. Signal filtering. Digital filters.
4. Digital controllers. Digital implementation of PID controllers and advanced controllers.

Part II: Hardware for embedded systems, common devices and peripherals - Programming languages and development tools
5. Study of different types of microcontrollers.
6. Applications and examples of implementation of filters and digital control systems.

6386 FORMAL METHODS

Introduction.
Mathematical Fundamentals.
Model-Based Specification Languages.
Properties-Based Specification Languages.
Formal verification techniques.

6387 NEW TECHNOLOGIES AND ENTERPRISES

New technologies in the digital economy. Introduction to the relational dimension in organizations.
Formalization of social, technological and business networks. Mathematical framework
Centrality, local structure and macroscopic properties.
Random models. Information dissemination models.

6388 DATA MINING

Introduction to Data Mining.
Classification by trees and rules.
Bayesian classification, based on instances and by combination.
Association Rules.
Clustering.

6389 ADVANCED DEVELOPMENT OF SOFTWARE SYSTEMS

Concepts: Measurement and Quality.
Quality Management.
Software Measurement and Metrics.
Design defects.
Software Refactoring.
Re-engineering patterns.