

# Programme détaillé de la 1<sup>ère</sup> année du cycle préparatoire

## Semestre 1

### Module : Data Structures and Algorithms 1

| Semestre 1, CP       | VHS<br>C/TD/TP | VHH<br>Total<br>C/TD/TP | V.H. hebdomadaire |     |    | Coef | Crédits |
|----------------------|----------------|-------------------------|-------------------|-----|----|------|---------|
|                      |                |                         | C                 | TD  | TP |      |         |
| UE Fondamentales 1.1 | 90             | 6                       | 1.5               | 1.5 | 3  | 3    | 6       |

#### Course Description:

This course introduces basic programming techniques with a high-level programming language. Topics include a general introduction to computers and programming languages, development process, variables, data types, expressions and structures of flow control, functions/procedures, text files, arrays, and pointers.

#### Prerequisite :

**Evaluation Method :** Coursework (40 %) + Final Exam (60 %)

#### Course Content

- Introduction of Algorithmic and Problem Solving
  - Overview of algorithmic thinking and problem-solving techniques
  - Steps involved in problem-solving
  - Introduction to programming concepts
- Introduction to Programming with C++
  - Basics of C++ programming language
  - Variables, data types, and expressions
  - Input and output operations using standard streams
  - Basic arithmetic operations
- Control Structures
  - Conditional statements (if-else, switch-case)
  - Looping and iteration (while, for)
  - Solving simple problems using control structure constructs
- Functions and Modular Programming
  - Introduction to functions
  - Function declaration, definition, and calling
  - Variable scopes
  - Parameter passing (by value, by reference)
  - Writing reusable code with functions
- Arrays and Strings
  - Introduction to arrays
  - Working with one-dimensional arrays
  - Manipulating strings and string operations

- Recursivity
  - Loop-based algorithms and iterations
  - Solving problems using loops and iterations
  - Introduction to Recursion
- Advanced Topics (Algorithms and static data structures)
  - Struct and enum
  - Arrays and multidimensional arrays
  - Basic operations on arrays (traversal, insertion, deletion, search)
  - Sorting algorithm ( bubble sort)
  - Searching algorithm (linear search)
  - File Handling and Streams

## References

- Paul J. Deitel and Harvey Deitel, *C++ How to Program (10th Edition)*. Pearson Education, 2016.
- Bjarne Stroustrup, *C++ Programming Language*, Addison-Wesley Professional, 2013.
- <https://cplusplus.com/doc/tutorial/>
- <https://en.wikiversity.org/wiki/C%2B%2B/Introduction>

## Module : Foundational Mathematics

| Semestre 1, CP       | VHS<br>Totale<br>C/TD/TP | VHH<br>Totale<br>C/TD/TP | V.H. hebdomadaire |     |    | Coef | Crédits |
|----------------------|--------------------------|--------------------------|-------------------|-----|----|------|---------|
|                      |                          |                          | C                 | TD  | TP |      |         |
| UE Fondamentales 1.1 | 135                      | 9                        | 4.5               | 4.5 |    | 4    | 9       |

### Course Description:

This course introduces students to university Mathematics which are based on rigorous definitions and proofs. The first part will familiarise students with essential concepts of logic and reasoning, as well as, the basic elements of algebra. In the second part, students will be introduced to continuous mathematics' concepts such as sequences, limits and differentiation where emphasis will be put on proofs and demonstrations of the concepts they will learn.

### Prerequisite : None

**Evaluation Method :** Coursework (40 %) + Final Exam (60%)

### Course Content

- Concepts of Logic
- Complex Numbers
- Sets and Applications
- Combinatorics and counting
- Arithmetic in  $\mathbb{Z}$
- Binary relations on a set
- Algebraic Structures
- Polynomials
- Real Number Fields
- Real Numbers Sequences
- Limits and Continuity of Functions
- Differentiability and Taylor Expansion
- Basic Functions

### References

- Stephen Abbott, Understanding Analysis, Springer – 2<sup>nd</sup> Edition, 2015.
- Marc Peter Deisenroth, Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press. 2020
- M. Hazi, De mes cahiers d'Analyse, OPU
- Amara Hitta, Cours D'Algèbre et exercices corrigés, OPU, 2014
- A. Khelladi, Introduction à l'Analyse mathématique, OPU, 2004
- Peter D. Lax and Maria Shea Terrell, Calculus with Applications, Springer – 2<sup>nd</sup> Edition, 2013
- Jean-Pierre Marco et Laurent Lazzarini, Mathématiques L1, Pearson, 2<sup>ème</sup> édition, 2013
- Eric Lehman F Thomson Leighton Albert R Meyer, Mathematics for Computer Science, MIT OpenCourseWare, 2017
- James Stewart, Single Variable Calculus, Cengage Learning – 2015

## Module : Digital Systems

| Semestre 1, CP         | VHS<br>C/TD/TP | VHH<br>Total<br>C/TD/TP | V.H. Hebdomadaire |     |    | Coef | Crédits |
|------------------------|----------------|-------------------------|-------------------|-----|----|------|---------|
|                        |                |                         | C                 | TD  | TP |      |         |
| UE Methodologiques 1.1 | 45             | 3                       | 1.5               | 1.5 |    | 3    | 4       |

### Course Description

The course addresses the concepts, principles and techniques of designing digital systems. The course teaches the fundamentals of digital systems applying the logic design and development techniques. This course forms the basis for the study of advanced subjects like Computer Architecture and Organization. Students will learn principles of digital systems logic design.

**Prerequisite :** None

**Evaluation Method :** Coursework (40%) + Final Exam (60%)

### Course Content

- Number Systems
- Boolean Algebra
- Combinational Logic Circuits
- Sequential Circuits
  - Flip-Flops
  - Finite State Machines
  - Registers
  - Standard Sequential Logic Circuits
- Computer Organisation
  - Von Neumann Architecture / Harvard Architecture
  - Data Path and Memory Bus
  - Arithmetic and Logic Unit (ALU)
  - Memory
  - Control Unit (CU)
  - Input/Output

### References

- William Stallings, Computer Organization and architecture : designing for performance 11th edition 2019
- Andrew S. Tanenbaum, & Todd Austin, Structured Computer Organization, 6th edition 2012.
- Paolo Zanella, Yves Ligier, Emmanuel Lazard, Architecture et technologie des ordinateurs : Cours et exercices corrigés - 6 Edition. Dunod. 2018.
- Thomas L. Floyd. Digital Fundamentals, 11th Edition. Pearson, 2015.

## Module : Information Technology Essentials

| Semestre 1, CP     | VHS<br>C/TD/TP | VHH Total<br>C/TD/TP | V.H. Hebdomadaire |    |     | Coef | Crédits |
|--------------------|----------------|----------------------|-------------------|----|-----|------|---------|
|                    |                |                      | C                 | TD | TP  |      |         |
| UE Découvertes 1.1 | 45             | 3                    | 1.5               |    | 1.5 | 2    | 4       |

### Course Description:

This class includes broad coverage of technology concepts and trends underlying current and future developments in information technology, and fundamental principles for the effective use of computer-based information systems. There will be a special emphasis on networks and distributed computing, including the World Wide Web. Other topics include: hardware and operating systems, software development tools and processes and electronic commerce. This course is intended for students with little or no background in computer technology.

**Prerequisite :** None

**Evaluation Method :** Coursework (40 %) + Final Exam (60%)

### Course Content

#### Part 1 : Fundamentals of Computing

- Operating Systems
- Software Systems
- Programming Languages

#### Part 2 : Office Suite

- Word
- Excel
- Latex

#### Part 3 : Web Technology

- The Internet and World Wide Web (DNS, HTTP, FTP, SSL/TLS, ...)
- Three tiers architecture (Browser/Web server/DBMS)
- HTML Basics
- CSS for Styling
- Search Engines
- Websites

#### Part 4 : Emerging Technologies

- Recent Technologies
- Computer Science in other fields

### References

- White, Ron, et. al. How Computers Work. 2004.
- Gralla, Preston, et. al. How the Internet Works. Que Publishing. 2006.
- G.Michael Schneider, Invitation to Computer Science (Introduction to CS) 6th Edition, Cengage Learning, 2012

## Module : English 1

| Semestre 1, CP       | VHS<br>C/TD/TP | VHH Total<br>C/TD/TP | V.H. Hebdomadaire |    |    | Coef | Crédits |
|----------------------|----------------|----------------------|-------------------|----|----|------|---------|
|                      |                |                      | C                 | TD | TP |      |         |
| UE Transversales 1.1 | 45             | 3                    |                   | 3  |    | 1    | 4       |

### Course Description:

This course aims to develop students' English language proficiency specifically for business purposes. It focuses on enhancing reading, writing, listening, and speaking skills required to effectively communicate in various business contexts. The course covers topics such as business communication, negotiations, presentations, and professional writing. Students will engage in interactive activities, case studies, business simulations, and real-world business scenarios to strengthen their business vocabulary, critical thinking abilities, and professional communication skills.

**Prerequisite :** None

**Evaluation Method :** Coursework (40 %) + Final Exam (60%)

### Course Content

- Introduction to English for Business Purposes
- Writing a CV
- Communication Skills
- Business Vocabulary
- Business Presentations

### References

- David Grant, Jane Hudson, John Hughes, Business Result Pre-Intermediate. Student's Book, Oxford University Press, 2017
- Ian MacKenzie, English for Business Studies Student's Book: A Course for Business Studies and Economics Students, Cambridge University Press, 2010

## Module : Critical Thinking and Creativity Skills

| Semestre 1, CP       | VHS<br>C/TD/TP | VHH Total<br>C/TD/TP | V.H. Hebdomadaire |      |    | Coef | Crédits |
|----------------------|----------------|----------------------|-------------------|------|----|------|---------|
|                      |                |                      | C                 | TD   | TP |      |         |
| UE Transversales 1.1 | 22.5           | 1.5                  | 0.75              | 0.75 |    | 1    | 3       |

### Course Description:

This course introduces students to brain main functions, patterns of thinking, ideas generating, evaluating, implementing, and problem solving strategies and techniques. Furthermore, the students will be exposed to different blocks to critical thinking and creativity, and how to overcome them. This course is more practical than theoretical which enables students to develop their creative and innovative mind set. In addition, digital creativity will be highlighted, and direct students to develop it.

**Prerequisite :** None

**Evaluation Method :** Coursework (40 %) + Final Exam (60%)

### Course Content

- Introduction: Importance of skills for future employment. Importance of creativity and critical thinking as soft skills.
- The brain's main structure: left brain – right brain – upper brain - lower brain.
- The brain main functions: Left and right brain functions, upper and lower brain functions.
- The concept of Four-Quadrant Brain Model of Thinking Preferences”
- The Whole Brain concept.
- Relationship between the brain & skills.
- The Concept of Brain Dominance
- How does the “Four-Quadrant Model” relate to the physical brain?
- How to develop creative problem solving?
- Divergent & convergent thinking
- How to improve students’ critical thinking skills?
- Critical thinking barriers, and how to overcome them.
- Creative thinking barriers, and how to overcome them.
- Digital Creativity

### References

- العياصرة، وليد رفيق. (2011). التفكير الناقد واستراتيجيات تعليمه. دار أسامة للنشر والتوزيع، الأردن.
- عشوي، مصطفى وآخرون. (2021). مهارات التفكير النقدي لدى طلاب الجامعات العربية: دراسة ميدانية مقارنة. شركة الأصالة للنشر. الجزائر.
- Bruce, N. W. (2012). Critical Thinking. 6 th Ed. Pearson, Boston.
- Foresman, A. G.& Fosl, S. P.; Watson, C. J. (2017). The Critical Thinking . Wiley Blackwell. USA.
- Joe, Y. F Law (2011). An Introduction to Critical Thinking and Creativity. Wiley Company.
- Lumsdaine, E.; Lumsdaine, M. (1995). Creative problem Solving. McGraw Hill Company. New York.
- Proctor, T. (2021). Absolute Essentials of Creative Thinking and Problem Solving. Rutledge, London.
- Smith, C. J. (2018). Critical Thinking. Second Edition, Wiley Blackwell, New Jersey.

# Semestre 2

## Module : Introduction to Linux

| Semestre 2, CP       | VHS<br>C/TD/TP | VHH<br>Total<br>C/TD/TP | V.H. Hebdomadaire |    |    | Coef | Crédits |
|----------------------|----------------|-------------------------|-------------------|----|----|------|---------|
|                      |                |                         | C                 | TD | TP |      |         |
| UE Fondamentales 2.1 | 67.5           | 4.5                     | 1.5               |    | 3  | 3    | 6       |

### Course Description

This course serves as a guided tour of the unix operating system, commonly used unix tools. The course is designed for individuals who wish to become familiar with unix and its data processing capabilities. Students will also use various scripting languages to write filters for transforming data from a variety of sources. By the end of the course, students will have developed a proficiency for UNIX, a basic understanding of the shell programming and a familiarity with tools including AWK, GIT and Make.

**Prerequisite :** Introduction to Programming

**Evaluation Method :** Coursework (40%) + Final Exam (60%)

### Course Content

- Introduction to Unix
- Linux utilities and commands
- Linux File System and permissions
- The shell
- Linux Guis
- Awk, Sed, Grep
- Advanced Shell Scripting
- Networking and Internet
- System Administration and Security
- Programming Tools

### References

- Sumitabha Das, Your UNIX/LINUX: The Ultimate Guide. McGraw Hill, 2012.
- Mike Joy, Stephen Jarvis and Michael Luck. Introducing Unix and Linux. Palgrave Macmillan. 2002
- Mokhtar Ebrahim and Andrew Mallett, "Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming" 2018



## Module : Object Oriented Programming

| Semestre 2, CP       | VHS<br>C/TD/TP | VHH Total<br>C/TD/TP | V.H. Hebdomadaire |     |     | Coef | Crédits |
|----------------------|----------------|----------------------|-------------------|-----|-----|------|---------|
|                      |                |                      | C                 | TD  | TP  |      |         |
| UE Fondamentales 2.1 | 67.5           | 4.5                  | 1.5               | 1.5 | 1.5 | 4    | 6       |

### Course Description:

This course introduces fundamental conceptual tools and their implementation of object-oriented design and programming such as: object, type, class, implementation hiding, inheritance, parametric typing, function overloading, polymorphism, source code reusability, and object code reusability. Object-Oriented Analysis/Design for problem solving. Implementation of the Object-Oriented programming paradigm is illustrated by program development in OO languages (The programming language is the same as the one taken in the introductory programming course ).

**Prerequisite :** Introduction to programming

**Evaluation Method :** Coursework (40 %) + Final Exam (60%)

### Course Content

- Introduction to OOP
- Classes and Objects
- Methods and Overloading
- Encapsulation
- Abstraction
- Dynamic Memory Allocation in OOP
- Inheritance and Polymorphism
- Exception Handling

### References

- Paul J. Deitel and Harvey Deitel, *C++ How to Program (10th Edition)*. Pearson Education, 2016.
- Robert Lafore, *Object-Oriented Programming in C++*, 2002

## Module : Mathematical Analysis 1

| Semestre 2, CP         | VHS<br>C/TD/TP | VHH<br>Total<br>C/TD/TP | V.H. Hebdomadaire |    |    | Coef | Crédits |
|------------------------|----------------|-------------------------|-------------------|----|----|------|---------|
|                        |                |                         | C                 | TD | TP |      |         |
| UE Methodologiques 2.1 | 90             | 6                       | 3                 | 3  |    | 3    | 6       |

### Course Description:

In this course, students will develop more advanced concepts of mathematical continuous analysis such as limited development, primitives and acquire a deeper understanding of integrals.

### Prerequisite : Foundational Mathematics

### Evaluation Method : Coursework (40 %) + Final Exam (60%)

### Course Content

- Limited Developments
- Calculation of primitives
- Riemann integral
- Generalised Integrals
- Differential Equations - Basic Study

### References:

- M. Hazi, De mes cahiers d'Analyse, OPU, 2015
- A. Khelladi, Introduction à l'Analyse mathématique, OPU, 2004
- Peter D. Lax and Maria Shea Terrelli, Calculus with Applications, Springer – 2nd Edition, 2013
- James Stewart, Single Variable Calculus, Cengage Learning – 2015

## Module: Linear Algebra

| Semestre 2, CP         | VHS<br>C/TD/TP | VHH<br>Total<br>C/TD/TP | V.H. Hebdomadaire |    |    | Coef | Crédits |
|------------------------|----------------|-------------------------|-------------------|----|----|------|---------|
|                        |                |                         | C                 | TD | TP |      |         |
| UE Methodologiques 2.1 | 90             | 6                       | 3                 | 3  |    | 4    | 6       |

### Course Description:

This course will provide students with all essential linear algebra tools to enable them to understand the mathematical foundations of machine learning and data mining algorithms. Students will become familiar with matrix manipulations and calculations. In addition, they will learn about concepts such as eigenvalues and vectors, diagonalisation, matrix triangulation and orthogonality.

The last chapter is dedicated to symmetric matrices and quadratic forms.

**Prerequisite :** Foundational Mathematics

**Evaluation Method :** Coursework (40 %) + Final Exam (60%)

### Course Content

#### Part 1

- Vector space
- Dimension and basis
- Linear applications
- Matrices
- Solving Systems of Linear Equations
- Eigenvalues and Eigenvectors and Diagonalization

#### Part 2

- Matrix Triangularisation
- Orthogonality
- Symmetric Matrices and Quadratic Forms

### References

- Strang, G. (2016) Introduction to Linear Algebra, (5th Edition), Wellesley-Cambridge Press.
- Lay, D.C., Lay, S.R., and McDonald, J.J. (2015) Linear Algebra and Its Applications (5th Edition), Pearson.
- Axler, S. (2015) Linear Algebra Done Right (3rd Edition), Springer.
- Kuldeep Singh (2013) Linear Algebra: Step by Step (1st Edition), Oxford University Press.
- Introduction à l'Algèbre linéaire, Benali BENZAGHOU, OPU, 2015.
- Mark Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020
- Amara Hitta, Cours D'Algèbre et exercices corrigés, OPU, 2014

## Module : Introduction to Statistics

| Semestre 2, CP         | VHS<br>C/TD/TP | VHH Total<br>C/TD/TP | V.H. Hebdomadaire |     |    | Coef | Crédits |
|------------------------|----------------|----------------------|-------------------|-----|----|------|---------|
|                        |                |                      | C                 | TD  | TP |      |         |
| UE Methodologiques 2.1 | 45             | 3                    | 1.5               | 1.5 |    | 3    | 3       |

### Course Description:

In this introductory course on statistics, students will learn about essential concepts of statistics and probability. In the first half of the course, students will learn the basic tools for statistical analysis such as graphical and numerical representations of the different types of data. In the second half, the foundations of probability theory are introduced.

**Prerequisite :** Foundational Mathematics

**Evaluation Method :** Coursework (40 %) + Final Exam (60%)

### Course Content

- Basic concepts and statistical vocabulary
  - Basic concepts of statistics
  - Statistical tables and graphical representation
- Numerical representation of data
  - Central tendency or positional characteristics
  - Dispersion characteristics
- Contingency Tables
- Correlation and Regression
- Probability
  - Combinatorial analysis
  - Probability Space
  - The relationship between probability theory and set theory.
  - Probability Calculation
  - Conditional probabilities, independence and compound probabilities

### References

- Probability. Jim Pitman. Springer, 1993.
- Probability Theory. Alexandr A. Borovkov. Springer, 2009.
- Probability and Statistics for Computer Science. David Forsyth. Springer, 2018.
- Probability Essentials. Jean Jacod and P. Potter. Springer, 2004.
- Neil A. Weiss, Introductory Statistics, 10th Edition, Addison-Wesley, 2015.
- Elements of Probability Theory T1, Moussedek BOUSSEBOUA, OPU, 2016.
- Elements of Probability Theory T2, Moussedek BOUSSEBOUA, OPU, 2016.
- Cours de probabilités, K. REDJDAL, OPU, 2015.

## Module : English 2

| Semestre 2, CP       | VHS<br>C/TD/TP | VHH Total<br>C/TD/TP | V.H. Hebdomadaire |    |    | Coef | Crédits |
|----------------------|----------------|----------------------|-------------------|----|----|------|---------|
|                      |                |                      | C                 | TD | TP |      |         |
| UE Transversales 2.1 | 45             | 3                    |                   | 3  |    | 1    | 3       |

### Course Description:

This course aims to develop students' English language proficiency specifically for business purposes. It focuses on enhancing reading, writing, listening, and speaking skills required to effectively communicate in various business contexts. The course covers topics such as business communication, negotiations, presentations, and professional writing. Students will engage in interactive activities, case studies, business simulations, and real-world business scenarios to strengthen their business vocabulary, critical thinking abilities, and professional communication skills.

**Prerequisite :** None

**Evaluation Method :** Coursework (40 %) + Final Exam (60%)

### Course Content

- Business Meetings and Discussions
- Writing: Emails and Correspondence
- Report Writing
- Proposal Writing

### References

- David Grant, Jane Hudson, John Hughes, Business Result Pre-Intermediate. Student's Book, Oxford University Press, 2017
- Ian MacKenzie, English for Business Studies Student's Book: A Course for Business Studies and Economics Students, Cambridge University Press, 2010