ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Advanced data base 2 (PLSQL, Transaction, Distributed Database) – Computer Technology	**ACADEMIC YEAR: 2021-22**
LECTURER(S) R. Chelouah	
NUMBER OF ECTS CREDITS ALLOCATED: 3	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S1**

PRESENTATION AND GENERAL OBJECTIVES:

The objective of this module is to give students a complete knowledge on database. This course is an introduction to advanced database system.

After the first course on introduction to database, we move on to more advanced concepts:

- optimal implementation of treatments on the DBMS
- PLSQL
- XMLType and XML Query
- Explane plan and optimization of queries (Index and Clusters)
- design of distributed databases,
- safety management through roles

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

- Processing in the database: the language PL/SQL, the triggers, the procedures, functions and packages
- XMLType, XMLquery
- Introduction to the database management: SPARC architecture, the tablespace, the repository, accelerators, indexes (b-trees, bitmaps,inversed), clusters, request plans
- Distributed database : the concept (single MCD / multiple MLD), the various kinds of fragmentation (horizontal, vertical and mixed), reconstituting views, materialized views, data base links
- Roles in a database : the application roles, the other roles, the system privileges, the object privileges

PREREQUISITES AND COREQUISITES (IF APPLICABLE):

Introcution to RDBMS and SQL

TEACHING METHODS:

6 hours of lectures and 12 hours of tutorials

MEANS OF EVALUATION:

Final exam through a student-project. No resit exam.

LEARNING OUTCOMES:

AT THE END OF THE COURSE MODULE, THE STUDENTS WILL become a designer, an administrator of a distributed and high-volume database

BIBLIOGRAPHY:

- PL/SQL TUTORIAL Simply Easy Learning by tutorialspoint.com
- *Advanced Database Systems* (The Morgan Kaufmann Series in Data Management Systems) Hardcover – May 15, 1997

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Advanced Functional programming with Scala – Computer Technology	**ACADEMIC YEAR: 2021-22**
LECTURER(S) D. Zaouche	
NUMBER OF ECTS CREDITS ALLOCATED: 3	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S1**

PRESENTATION AND GENERAL OBJECTIVES:
Advance learning functional programming with the Scala language and its implementation to data science.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:
Definition of functional programming (functional paradigm vs imperative paradigm)
Difference between strongly / weakly / untyped; statically / dynamically typed
Valuation by value vs by name.
Difference between def, val and var.
(Recall on) recursive functions (terminal and non-terminal)
The different "primitive" types of scala
Creation of internal function (to a function)
notions of generic functions, classes, listing, currying, pattern matching, collections, feature, case class, future, stream

1. Reminder on Basics scala:
Functions scala
Classes and objects
Collections
2. Advanced concepts:
Future and promise
Stream in scala
Akka, framework for advanced scala (multi-agents)
Play, framework for advanced scala (web reactive application)

PREREQUISITES AND COREQUISITES (IF APPLICABLE):
Know other functional programming languages such as Python
TEACHING METHODS:
6 hours of lectures and 12 hours of tutorials
MEANS OF EVALUATION:
Final exam. No resit exam.
LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO easily parallelize Big Data processing on architectures such as hadoop MapReduce
BIBLIOGRAPHY:
Functional Programming in Scala, Paul Chiusano and Runar Bjarnason, September 2014 ISBN 9781617290657 320 pages printed in black & white

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Advanced BI & Data Visualization – Business Intelligent	**ACADEMIC YEAR: 2021-22**
LECTURER(S): M. Radha Krishnan	
NUMBER OF ECTS CREDITS ALLOCATED: 3	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S1**

PRESENTATION AND GENERAL OBJECTIVES:

This course helps students to understand the BI Architecture, currents trends, BI solutions with examples, limitations of BI, importance of data discovery & self-service data visualization, choosing the right chart, and get hands on cutting edge data visualization tools with practical exercises

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

This course introduces in the first the concept of decision-making via a chain of decisions. At the end of this course, students must understand the fundamental differences between both the operational and decision-making points of views within a functional architecture.

After the course of decision-making theory, we teach students to effectively implement a chain of decisions by introducing them to three basic steps and their tools: Extract, transform and load (ETL), Representation in cube (OLAP) and Reporting

Lecture 1– BI theory

Introduction to Business Intelligence, analytics and BI market trends, BI Architecture, BI Solutions, BI model design, limitations of BI tools, importance of data discovery, choosing the right chart, and self-service data visualization.

Decision-making: Who and why? Original concept, The principles of construction, Basic modelling, Family tools, Modelling techniques, From the operational data base to decisional data base and Current Trends

Lecture 2 - Advanced BI Design

Introduction to QlikSense best practices and practical exercises, Introduction to Tableau, best practices, practical and real-life exercises, Data warehousing, advanced databases, data warehouse architecture, ETL best practices and limits, and data management solutions & limitations BI Architecture, BI Solutions – Example of SAP BI Suite Tools, BI model design, Limits of traditional BI tools, Introduction to data discovery with Qlik tools

Lecture 3 – Reporting with Qlik Sense

Quick start, Load data, Create dashboard, Transform data – Model, Advanced features

Lectures 4 and 5 : Project

Advanced BI & Data visualization project with real-life analytics dataset

PREREQUISITES AND COREQUISITES (IF APPLICABLE):

have knowledge of spreadsheets, graphers and statistics

TEACHING METHODS:

18 hours of lectures.

MEANS OF EVALUATION:

Student project.

LEARNING OUTCOMES :

AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO be able to extract data, clean it, reorganize it and represent it in the form of a graph

BIBLIOGRAPHY:

-*The Data Warehouse Lifecycle Toolkit* (2nd ed.), Kimball Ralph, Margy Ross, Warren Thornthwaite, Joy Mundy, Bob Becker, 2008, Wiley

-*Mastering Data Warehouse Design Relational and Dimensional Techniques*, Claudia Imhoff, Jonathan G. Geiger, Nicholas Galemmo John

-Students will receive the documentation of the various tools (Qlikview, essbase, Business Objects, etc.) with which they were trained.

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Forecasting Models – Data Exploration	**ACADEMIC YEAR: 2021-22**
LECTURER(S): H. Maatouk	
NUMBER OF ECTS CREDITS ALLOCATED: 3	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S1**

PRESENTATION AND GENERAL OBJECTIVES:
The purpose of this course is the study of a sequence of numeric values representing the evolution of a quantity over time (temporal or time series). Such sequences of values can be expressed mathematically in order to analyze the behaviour, usually to understand the past and to predict future behaviour (short-term forecasting).

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:
The discussed methods are:

- Introduction to short-term time series
- Single and double moving averages
- Single and double exponential smoothing
- Estimation of Trend
- Holt Model and Holt and Winter Model
- Estimation of the seasonal variations
- Time series analysis with seasonality with multiple linear regressions
- The detection of seasonality by autocorrelation
- Tests on prediction and autocorrelation errors
- The AR, MA, ARMA and ARIMA models
- The software used is EXCEL and SAS

PREREQUISITES AND COREQUISITES (IF APPLICABLE): know the descriptive statistics and inferential analyzes.

TEACHING METHODS:
8 hours of lectures and 16 hours of tutorials

MEANS OF EVALUATION:
Final exam. No resit exam.

LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO master statistical analysis: descriptive analyzes, inferential analyzes, and predictive analyzes.

BIBLIOGRAPHY:
Statistical Methods for Forecasting, Bovas Abraham, Johannes Ledolter Publisher: Wiley

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Semantic web and Ontology – Data Exploration	**ACADEMIC YEAR: 2021-22**
LECTURER(S): external lecturer	
NUMBER OF ECTS CREDITS ALLOCATED: 3	**COURSE CODE (IF APPLICABLE) :**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S1**

PRESENTATION AND GENERAL OBJECTIVES:
The purpose of this course is to introduce the field of semantic web and ontologies and their uses in knowledge representation on the web as well as in the field of information retrieval. Tools and frameworks used for practical work in this course are: Protégé, Jena and Altova (XMLSPY and SemanticWorks).

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:
1. Motivations, Definition and cake model
2. Ontology, theoretical notion and construction
3. Ontology types: domain, application and resolution ontology
4. Ontology representation, formalism and languages: XML, RDF, RDF(s) and OWL
5. Application: SPARQL and DBPEDIA
6. Ontology annotation, indexation and alignment
7. Application: Amazon recommendation system using semantic taxonomy.

PREREQUISITES AND COREQUISITES (IF APPLICABLE): Information structuring (XML, DTD, XSD, Jason)

TEACHING METHODS:
6 hours of lectures and 12 hours of tutorials

MEANS OF EVALUATION:
Final exam. No resit exam.

LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO create ontologies, query semantic databases

BIBLIOGRAPHY:
-G.Antoniou and F.V. Harmelen. *A semantic web primer*. MIT Press, Massachusetts Institute of Technology, 2004.
-W3C Tutorials: www.w3.org/

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: SAS Analysis – Data Exploration	**ACADEMIC YEAR: 2021-22**
LECTURER(S): SAS lecturer	
NUMBER OF ECTS CREDITS ALLOCATED: 2	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S1**

PRESENTATION AND GENERAL OBJECTIVES:

Learn how to modify data for better analysis results, build and understand predictive models such as decision trees and regression models, compare and explain complex models, generate and use score code, apply association and sequence discovery to transaction data or use other modelling tools such as rule induction, gradient boosting, and support vector machines.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

1.Introduction
2.Accessing and Assaying Prepared Data: creating a SAS Enterprise Miner project, library, and diagram, defining a data source, exploring a data source.
3.Introduction to Predictive Modelling with Decision Trees: cultivating decision trees, optimizing the complexity of decision trees, understanding additional diagnostic tools, autonomous tree growth options.
4.Introduction to Predictive Modelling with Regressions: selecting regression inputs, optimizing regression complexity, interpreting regression models, transforming input, categorical inputs, polynomial regressions.
5.Introduction to Predictive Modelling with Neural Networks and Other Modelling Tools: introduction to neural network models, input selection, stopped training, other modelling tools
6.Model Assessment: model fit statistics, statistical graphics, adjusting for separate sampling, profit matrices.
7.Model Implementation: internally scored data set, score code modules.
8.Introduction to Pattern Discovery: cluster analysis, market basket analysis (self-study).
9.Special Topic: ensemble models, variable selection, categorical input consolidation, surrogate models, SAS Rapid Predictive Modeler.
10.Case Studies: segmenting bank customer transaction histories, association analysis of Web services data, creating a simple credit risk model from consumer loan data, predicting university enrolment management.

PREREQUISITES AND COREQUISITES (IF APPLICABLE): Data analysis

TEACHING METHODS:

6 hours of lectures and 6 hours of tutorials

MEANS OF EVALUATION:

Student project

LEARNING OUTCOMES:

AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO master the SAS tool for analytics

BIBLIOGRAPHY:

Herb Edelstein discusses the usefulness of data mining, A. Beck, 1997, DS Star. Vol. 1, No. 2. Available at www.tgc.com/dsstar/
SAS Institute Inc. 2002. *SAS® 9 Procedures Guide*. Cary, NC: SAS Institute Inc.
SAS Institute Inc. 2002. *SAS/STAT® 9 User's Guide*, Volumes 1, 2, and 3. Cary, NC: SAS Institute Inc.
Computer Systems That Learn: Classification and Prediction Methods from Statistics, Neural Nets, Machine Learning, and Expert Systems, Weiss, S. M. and C. A. Kulikowski, 1991, San Mateo, CA, Morgan Kaufmann

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Data Mining Approach (Time series, logistic regression, Bagging, Boosting, Random Forest, Neutral Network) – Data Exploration	**ACADEMIC YEAR: 2021-22**
LECTURER(S): H. Senoussi	
NUMBER OF ECTS CREDITS ALLOCATED: 3	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S1**

PRESENTATION AND GENERAL OBJECTIVES:

This course presents a detailed approach of the applications and fields concerned by data mining. We will focus on several models and the way that they are put into use on different types of data. This course consists of two parts, a theoretical part and an application part. The theoretical part provides an analytical study of symbolic statistical and connectionist learning techniques. The practical work is done on Weka. An Introduction to the issue of "Big Data" and parallel data mining will then be studied. MapReduce and Mahout Framework are used.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

- Supervised or unsupervised learning. Notions of precision and recall, apparent error, confusion matrix and cross-validation.
- Methods & Techniques of supervised machine learningBayesian classifier naïve: the decision trees, Algorithms ID3, C4.5, Cart., the foil and reverse lookup algorithm, the association rules : apriori algorithms and aprioriTid. Generation of association rules.
- Bayesian networks, Discretization methods and variable selection: forward and backward inferences , Law of Bayesian network, Structure Database : linear, V or hat, Problems of prediction and diagnosis.
- Regression
- Bootstrap and aggregation of models: Bootstrap, Aggregation by Bagging, Agregation by Boosting, Applications
- Random forest
- Artificial neural network: The SVM, Neural models
- Deep learning

PREREQUISITES AND COREQUISITES (IF APPLICABLE): have data mining bases such as datamining classification, clustering, association rules, etc.

TEACHING METHODS:

7 hours of lectures and 14 hours of tutorials

MEANS OF EVALUATION:

Final exam. No resit exam.

LEARNING OUTCOMES:

AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO have a good mastery in data processing and knowledge extraction, and introduction to machine learning

BIBLIOGRAPHY:

-Fayyad, G. Piatetsky-Shapiro, P. Smyth, and R. Uthurusamy. *Advances in Knowledge Discovery and Data Mining*, AAAI/MIT Press, 1996.
-Ian H. Witten; Eibe Frank *Data Mining: Practical machine learning tools and techniques*, 2nd Edition. Morgan Kaufmann, 2005.
-Sean Owen, Robin Anil, Ted Dunning, and Ellen Friedman. *Mahout in Action*. Manning Publications, 1 edition, January 2011.

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Heuristics - Optimization	**ACADEMIC YEAR: 2021-22**
LECTURER(S) R. Chelouah	
NUMBER OF ECTS CREDITS ALLOCATED: 3	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S1**

PRESENTATION AND GENERAL OBJECTIVES:
This course presents techniques and algorithms that are used for solving ha hard and non-linear problems. This course is devoted to study stochastic optimization methods.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:
Heuristics and optimization
Mono agent approach: simulated annealing (SA), taboo search (TS)
Discrete Multi Agent Approaches: Evolutionary Algorithms (EA), Ant Colony Optimization (ACO)
Continuous agent multi approaches: Particle Swarm Optimization (PSO), Artificial bee colony algorithm (ABC)
Programming in Python language

PREREQUISITES AND COREQUISITES (IF APPLICABLE): have a basis in python programming and optimization

TEACHING METHODS:
6 hours of lectures and 9 hours of tutorials.

MEANS OF EVALUATION:
Final exam. No resit exam.

LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO to solve and optimize complex problems

BIBLIOGRAPHY:
-*Handbook of Heuristics*, Editors: Martí, Rafael, Pardalos, Panos M., Resende, Mauricio G. (Eds.)
-*Meta-heuristics for System Design Engineering*, Authors Rachid Chelouah, Claude Baron, Marc Zholghadri and Citlalih Gutierrez, Foundations of Computational Intelligence Volume 3 pp 387-423

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Master thesis – Personal Work	**ACADEMIC YEAR: 2021-22**
LECTURER(S): several supervisors	
NUMBER OF ECTS CREDITS ALLOCATED: 4	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED:M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S1**

PRESENTATION AND GENERAL OBJECTIVES:

- The first he objective of the course is to explain the two main methods of project management used today in software development projects: the V cycle and AGILE methodologies.
- The second objective of this module is to introduce to methodologies to analyze the scientific documents related to one of the three pillars of the master. This allows the student to prepare for the research project completed
- The last objective is initiating students to research in the different fields that make up their master's in architecture, data exploration and optimization.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

- Course on Agile methods (From V model to "Agile" method, The manifest and the le panorama of Agile methods, SCRUM, XP, Kanban)
- Provide students scientific papers relating to courses seen during the current semester (Parallel Architecture, Data mining, data exploration, Optimization, ...).
  - The student will choose one paper and will make scientific critique as if he is a reviewer:
  - Present the authors problems,
  - How the authors are modeled their problems?
  - The methods chosen by the authors to solve their problems.
  - How the authors interpreted their results?
  - Have they presented perspectives to their work?
  - The bibliography is it e recent? well adapted to their studies? etc ...
- Provide students research subjects to prepare their master thesis

PREREQUISITES AND COREQUISITES (IF APPLICABLE): Know how to read and analyze a scientific article

TEACHING METHODS:

Number of working hours is free but must be greater than 24 hours per semester. A part is done face-to-face and another in distance

MEANS OF EVALUATION:

writing of a report and defense of the master thesis

LEARNING OUTCOMES:

AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO Analyze a scientific problem, make a bibliography, propose your own solution, implement it and compare it to the other proposed solutions

BIBLIOGRAPHY:

- Extreme programming pocket guide
- Agiles services and processes: Thierry Chamfrault et Claude Durand
- Balancing Agility and Discipline de Guide for the PerplexedDe Barry Boehm et Richard Turner chez Addison Wesley
- bibliography according to the chosen subject

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: NoSQL – Data Exploration	**ACADEMIC YEAR: 2021-22**
LECTURER(S): R. Chelouah	
NUMBER OF ECTS CREDITS ALLOCATED: 2	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S2**

PRESENTATION AND GENERAL OBJECTIVES:
The objective of this module is to give students an understanding of the issues and challenges around NOSQL (Not Only SQL) technology and a variety of jurisdiction and implementation of certain technologies in a business context. This course is an introduction to Cloud Computing. In this course, students can learn how to make good use of Cloud Computing in Information Systems.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

•Overview of Cloud Computing, Origins and definitions, Advantages and disadvantages
•Types of Cloud: SaaS, PaaS, IaaS
•The known and established Cloud Operators on the market (study of tender): Google Apps, Chrome OS, Amazon Web Services, Windows Azure coupled with Visual Studio 2010, Sales Force
•Storage paradigm: Oriented column, Oriented Key/Value, Oriented document, Oriented graph
•Case Study, Engine and Google Big Table: The column-oriented model, the data structure dynamic, MongoDB and BSON, the contribution of the paper-oriented organization

PREREQUISITES AND COREQUISITES (IF APPLICABLE): relational database

TEACHING METHODS:
6 hours of lectures and 9 hours of tutorials

MEANS OF EVALUATION:
Student project and exam

LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO know the new volumetric and unstructured database paradigms used in industry.

BIBLIOGRAPHY:

•Cloud Computing Journal: http://cloudcomputing.sys-con.com/
•Cloud Times: http://cloudtimes.org/
•Computer World: http://www.computerworld.com/s/topic/158/Cloud+Computing
•Cloud Computing for beginners: http://dwachira.hubpages.com/hub/What-is-cloud-computing-A-beginners-approach

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Social Network Analysis – Data Exploration	**ACADEMIC YEAR: 2021-22**
LECTURER(S): external lecturer.	
NUMBER OF ECTS CREDITS ALLOCATED: 2	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S2**

PRESENTATION AND GENERAL OBJECTIVES:
In many different contexts graphs are used to model complex systems interactions; we are handling now frequently in biological networks, social networks, web graphs modelling, graphs of peer-to-peer exchanges, for example. These graphs usually have nontrivial common properties that distinguish them from random graphs. The objective of this course is to introduce the issues and analysis techniques and search for this type of graphs. We rely on the Python language and NetworkX1 library.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

1.Graph representation actors, relations, and links
2.Example: Small world, Internet communities
3.Social networks analysis: Degree, proximity, prestige, betweenness centrality, Clustering coefficient, Diameter
4.Communities' detection models and applications: Divisive algorithms (Newman), agglomerative ones (Louvain)
5.New approaches for communities' detections: leaders based algorithms, genetic algorithms
6.Multipartite graph and communities detections
7.Links predictions: Films recommendation in a bipartite graph, application: Movie Lens
8.Big graphs visualization: software Igraph

PREREQUISITES AND COREQUISITES (IF APPLICABLE): The theory of graphs and the associated algorithms

TEACHING METHODS:
12 hours of lecture

MEANS OF EVALUATION:
Student Project and exam

LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO: Organize populations into communities, Analyze communities and extract information

BIBLIOGRAPHY:
-*Du simple tracement des interactions à l'évaluation des rôles et des fonctions des membres d'une communauté en réseau : une proposition dérivée de l'analyse des réseaux sociaux*, Mazzoni, ISDM – Information Sciences for Decision Making, 25, 2006, pp. 477-487 E
-*Social network analysis. Methods and applications*, S. Wasserman, K. Faust, New York, Cambridge University Press, 1994

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Text Mining and Natural Language – Data Exploration	**ACADEMIC YEAR: 2021-22**
LECTURER(S): H. Senoussi	
NUMBER OF ECTS CREDITS ALLOCATED: 2	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S2**

PRESENTATION AND GENERAL OBJECTIVES:
This course aims to provide students with the concepts and techniques of text analysis and classification of large masses of information. It shows the difference between natural language processing which focuses on the linguistic analysis and the text mining, which looks at statistical analysis.
We will work with the powerful SAS Text Miner tool.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:
1.Data Mining and Text Mining: for whom and for what?
2.Words and lemmatization
3.Linguistic Analysis
4.Statistical Analysis: Words and word frequency, Themes and factorial analysis of multiple correspondence, Themes and classification, and automatic extraction of keyword, Document Classification: decision tree and neural network, Open Queries: Markov chain

PREREQUISITES AND COREQUISITES (IF APPLICABLE): Data mining and machine learning

TEACHING METHODS:
8 hours of lectures and 10 hours of tutorial

MEANS OF EVALUATION:
Final exam. No resit exam.

LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO automatic analysis of newspaper texts, analysis of polytic speeches and others

BIBLIOGRAPHY:
-*Natural Language Processing with Python,* Steven Bird, Ewan Klein, Edward Loper, O'Reilly Media
-*The Text Mining Handbook Advanced Approaches in Analyzing Unstructured Data*, Authors: Ronen Feldman, James Sanger Publisher: Cambridge University Press
-*Text Mining and its Applications to Intelligence*, Alessandro Zanasi, CRM & KM chez WIT Press

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Artificial Intelligence – Data Exploration	**ACADEMIC YEAR: 2021-22**
LECTURER(S): R. Chelouah	
NUMBER OF ECTS CREDITS ALLOCATED: 2	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S2**

PRESENTATION AND GENERAL OBJECTIVES:
Learn how to represent problems research spaces and to model a problem in a states space.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

1. Modelling
2. Games –
   - A* Algorithm,
   - Minmax and Alpha-Beta algorithm,
   - Grundy function
   - Monte Carlo
3. Reinforcement learning
4. Machine learning
5. Deep learning

PREREQUISITES AND COREQUISITES (IF APPLICABLE): Optimization and heuristics

TEACHING METHODS:
8 hours of lectures and 10 hours of tutorials

MEANS OF EVALUATION:
Project and final exam.

LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO to do machine learning of complex system behavior

BIBLIOGRAPHY:
-*Machine Learning* (McGraw-Hill International Editions Computer Science Series) 1st Edition
by Tom M. Mitchell (Author)
-*Reinforcement Learning: An Introduction* (Adaptive Computation and Machine Learning) (Adaptive Computation and Machine Learning series) second edition by Richard S. Sutton (Author), Andrew G. Barto (Author**)**

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Multi-objective Optimization – Operations Research	**ACADEMIC YEAR: 2021-22**
LECTURER(S): S. Yassa	
NUMBER OF ECTS CREDITS ALLOCATED: 2	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S2**

PRESENTATION AND GENERAL OBJECTIVES:
The objective of this course is to provide students with methods and tools to master modelling and identify problems such as: Scheduling, Tracking, Spanning Tree, the Travelling Salesman Problem, Assignment, Vehicle routings, etc.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

1. Definitions and problems
2. Classification of methods
3. Aggregation methods: Weighted average method, Goal programming, Goal attainment, The min-max, ε-constraint
4. Non-aggregated methods and non-Pareto: Parallel Selection (VGA), Using genres, The lexicographic method
5. Methods based on Pareto
6. Resolution by metaheuristics: Simulated Annealing SA, Tabu Search TS, Genetic Algorithms GA, Ant Colony Optimization ACO, Particle Swarm Optimization PSO
7. Discussion

PREREQUISITES AND COREQUISITES (IF APPLICABLE): Heuristics and optimization

TEACHING METHODS:
4 hours of lectures and 8 hours of tutorials

MEANS OF EVALUATION:
Student project.

LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO model and solve difficult multiobjective optimization problems

BIBLIOGRAPHY:
-*Evolutionary Algorithms for Solving Multi-Objective Problems* (2nd ed.), Coello Coello, C. A.; Lamont, G. B.; Van Veldhuizen, D. A., 2007, Springer, ISBN 978-0-387-33254-3
-*Evolutionary Multiobjective Optimization. Theoretical Advances and Applications*, Ajith Abraham, Lakhmi Jain and Robert Goldberg, Springer, USA, 2005, ISBN 1-85233-787-7

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Game Theory – Operations Research	**ACADEMIC YEAR: 2021-22**
LECTURER(S): M. Manolessou	
NUMBER OF ECTS CREDITS ALLOCATED: 2	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S2**

PRESENTATION AND GENERAL OBJECTIVES:

Game theory provides tools to predict, understand, and optimize the result of complex decision-making processes. The purpose of this module is to introduce students to a few simple tools and examples of implementation. Game theory is applied in various fields such as economics, marketing, transport networks, energy, biology, and pursuit-evasion games.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

1. Game theory for decision-making
2. Introduction: Concepts of game theory, rationality, solution, utility
3. Static games with perfect information: Normal form games, Zero sum games, Two-player games, Multiplayer games: computation of coalitions, Prudent strategies, Dominant strategies, Nash equilibrium in pure strategies, Mixed strategies
4. Static games with incomplete information: Bayesian equilibriums,
5. Dynamic games: Extensive form games: decision trees, Sub Games Perfect Nash Equilibrium (SPNE), Differential games
6. Repeated games: Repeated games with finite and infinite horizon
7. Evolutionary Game Theory (EGT): Concept of population, Evolutionary Stable Strategies (ESS), Evolution process

PREREQUISITES AND COREQUISITES (IF APPLICABLE): no prerequisite to follow the course, just a basic level of knowledge in microeconomics and mathematics

TEACHING METHODS:

4 hours of lectures and 8 hours of tutorials

MEANS OF EVALUATION:

Student project.

LEARNING OUTCOMES:

AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO makes it possible to formalize the conflict situations inherent in a community of interacting individuals, to discuss and then to propose solutions to these conflicts.

BIBLIOGRAPHY:

-*Games and Dynamic Games*, Alain Haurie, Jacek B. Krawczyk, Georges Zaccour, World Scientific – Now Publishers Series in Business vol. 1, 2012

-*Decision Making using Game Theory, An Introduction for Managers*, Anthony Kelly, Cambridge University Press, 2003

-*Differential Games, A Mathematical Theory with Applications to Warfare and Pursuit, Control and Optimization*, Rufus Isaacs, John Wiley & Sons Inc, New York, 1965

-*Dynamic Noncooperative Game Theory*, 2nd edition, Tamer Basar, Geert Jan Olsder, Classics In Applied Mathematics, CL 23, SIAM, Philadelphia, 1999

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Constraint programming – Operations Research	**ACADEMIC YEAR: 2021-22**
LECTURER(S): R. Chelouah	
NUMBER OF ECTS CREDITS ALLOCATED: 2	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S2**

PRESENTATION AND GENERAL OBJECTIVES:
This course presents techniques and algorithms that are used for solving constraints. The interesting problematic dealing with finding efficient and optimized algorithms according to the presented problem is treated throughout this course. Used tools are: GNU Prolog and IBM CPLEX.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:
1. Constraint satisfaction problem, backtrack algorithms, anticipation and smaller domain choice algorithms
2. Consistency algorithms, AC1, AC3 & AC4 algorithms
3. Constraints in Gnu Prolog. N queen, Zebra problems, Sudoku, magic series, etc.
4. Global constraints, Hall intervals, Scheduling
5. Coloration and planning problem resolutions
6. CPLEX and OPL applications

PREREQUISITES AND COREQUISITES (IF APPLICABLE): optimization

TEACHING METHODS:
6 hours of lectures and 6 hours of tutorials

MEANS OF EVALUATION:
Project. No resit exam.

LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO formalize a problem find its objectives and associated constraints, and solve it

BIBLIOGRAPHY:
-*Essentials of Constraint Programming*, Thom Frühwirth and Slim Abdennadher, Springer, 2003
-*Programmation par Contraintes*, The Book Edition, Annick Fron, ISBN 978-918417-00-2.

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Supply Chain and Operational Analytics – Operations Research	**ACADEMIC YEAR: 2021-22**
LECTURER(S): M. Manolessou	
NUMBER OF ECTS CREDITS ALLOCATED: 2	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S2**

PRESENTATION AND GENERAL OBJECTIVES:

The first purpose of this course is to introduce the concept of supply chain management, to present the main building blocks, the main functions, the major business processes, and the performance measures.
The second one is to provide an overview of the role of Internet technologies and e-commerce in supply chain operations
The third par is to highlight the role of stochastic models (Markov chains, queuing networks); optimization models (linear programming, heuristics, constraint programming); and simulation in supply chain planning and decision-making.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

1. Building Blocks, Performance Measures, Decisions
2. Supply Chain Inventory Management
3. Mathematical Foundations of Supply Chain Solutions.
    - Supply Chain Planning
    - Supply Chain Facilities Layout
    - Capacity Planning
    - Inventory Optimization
    - Dynamic Routing and Scheduling
4. Case studies

PREREQUISITES AND COREQUISITES (IF APPLICABLE markov chain, optimization and matrix algebra

TEACHING METHODS:

6 hours of lectures and 9 hours of tutorials

MEANS OF EVALUATION:

Continuous assessment. No resit exam.

LEARNING OUTCOMES:

AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO accurately assess the needs, availability and capabilities of each link in the logistics and manufacturing chain, in order to better synchronize them and serve customers in the best possible conditions.

BIBLIOGRAPHY:

-N. Viswanadham. *Analysis of Manufacturing Enterprises*. Kluwer Academic Publishers.
-Y. Narahari and S. Biswas. *Supply Chain Management: Models and Decision Making*
-Ram Ganeshan and Terry P. Harrison. *An Introduction to Supply Chain Management*
-D. Connors, D. An, S. Buckley, G. Feigin, R. Jayaraman, A. Levas, N. Nayak, R. Petrakian, R. Srinivasan. *Dynamic modelling for business process reengineering*. IBM Research Report 19944,
-W.J. Hopp and M.L. Spearman. *Factory Physics: Foundations of Manufacturing Management*.

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Big Data and Advanced Analytics – Software and Architecture	**ACADEMIC YEAR: 2021-22**
LECTURER(S): M. Radha Krishnan	
NUMBER OF ECTS CREDITS ALLOCATED: 4	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S2**

PRESENTATION AND GENERAL OBJECTIVES:
This course helps students to understand well the Big Data eco-system, currents trends, highlight the Big Data challenges, allow students to build on-demand Big Data applications and show them how to solve advanced analytics problems with Big Data using cutting-edge technologies.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:
1. Introduction to Big Data, market trends, tools & technologies, why we need to analyze Big Data, highlight on advanced analytics use-case with Big Data
2. Hadoop: Introduction to Hadoop, Hadoop eco-system, hive, impala, pig, flume, kafka etc with class exercises
3. Spark: Overview, spark data frames, programming in Scala & PySpark with real-life examples & class exercises. And, Spark streaming example using Twitter & Scala
4. Spark details with concrete examples and advanced analytics exercises
5. Advanced analytics use cases with SparkML (Linear regression, Decision Tree, Artificial Neural Network, Sciket - Learn) with real-life datasets
6. Big Data project: Twitter sentiment analysis & Advanced analytics project

PREREQUISITES AND COREQUISITES (IF APPLICABLE):
Databases such Hbase, Python and Scala, MapReduce

TEACHING METHODS:
36 hours of lectures.

MEANS OF EVALUATION:
Student project.

LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO Perform analytics processing on a large volume of data

BIBLIOGRAPHY:
-*Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data*, Zikopoulos, Paul C.
-*Hadoop: The Definitive Guide* by Tom White Released June 2009 Publisher(s): O'Reilly Media, Inc. ISBN: 9780596521974e

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Master thesis with – Personal work	**ACADEMIC YEAR: 2021-22**
LECTURER(S)	
NUMBER OF ECTS CREDITS ALLOCATED: 3	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S2**

PRESENTATION AND GENERAL OBJECTIVES:
This course helps students to understand well the Big Data eco-system, currents trends, highlight the Big Data challenges, allow students to build on-demand Big Data applications and show them how to solve advanced analytics problems with Big Data using cutting-edge technologies.

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

1. Introduction to Big Data, market trends, tools & technologies, why we need to analyze Big Data, highlight on advanced analytics use-case with Big Data
2. Hadoop: Introduction to Hadoop, Hadoop eco-system, hive, impala, pig, flume, kafka etc with class exercises
3. Spark: Overview, spark data frames, programming in Scala & PySpark with real-life examples & class exercises. And, Spark streaming example using Twitter & Scala
4. Spark details with concrete examples and advanced analytics exercises
5. Advanced analytics use cases with SparkML (Linear regression, Decision Tree, Artificial Neural Network, Sciket - Learn) with real-life datasets
6. Big Data project: Twitter sentiment analysis & Advanced analytics project

PREREQUISITES AND COREQUISITES (IF APPLICABLE):

TEACHING METHODS:
Personal work with a supervisor

MEANS OF EVALUATION:
Student project

LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO

BIBLIOGRAPHY:

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: Internship (22 weeks minimum) – Personal Work	**ACADEMIC YEAR: 2021-22**
LECTURER(S)	
NUMBER OF ECTS CREDITS ALLOCATED: 6	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: English	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED:**

PRESENTATION AND GENERAL OBJECTIVES:

This internship will be done in a Laboratory or in a company.

The internship can take place in a research laboratory or in a company. The purpose of an internship in a company is twofold, to discover the world of the company, and above all, to see how a project is managed.

The trainee will be involved in a research project, and will participate in all phases of this project, from its conception to the realization of a POC (Proof Of Concept).

MEANS OF EVALUATION:

a report and a defense of the internship. No resit exam.

LEARNING OUTCOMES

AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO discover the business world, work in a group on a concrete project with strong constraints

ECTS COURSE CATALOGUE/INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

COURSE TITLE: French and Foreign Languages	**ACADEMIC YEAR:2021-22**
LECTURER(S)	
NUMBER OF ECTS CREDITS ALLOCATED: 1	**COURSE CODE (IF APPLICABLE):**
COURSE TYPE (COMPULSORY/OPTIONAL): Compulsory	**MODE OF DELIVERY: Face-to-face**
CYCLE (BACHELOR'S LEVEL, MASTER'S LEVEL): Master's	**YEAR OF STUDIES WHEN THE COURSE MODULE IS DELIVERED: M2**
LANGUAGE OF INSTRUCTION: depending on the class	**SEMESTER WHEN THE COURSE MODULE IS DELIVERED: S2**

PRESENTATION AND GENERAL OBJECTIVES:

COURSE SCHEDULE AND DETAILED CONTENT PER SESSION:

PREREQUISITES AND COREQUISITES (IF APPLICABLE):

TEACHING METHODS:
24 hours of tutorials

MEANS OF EVALUATION:

LEARNING OUTCOMES:
AT THE END OF THE COURSE MODULE, THE STUDENTS WILL BE ABLE TO

BIBLIOGRAPHY: